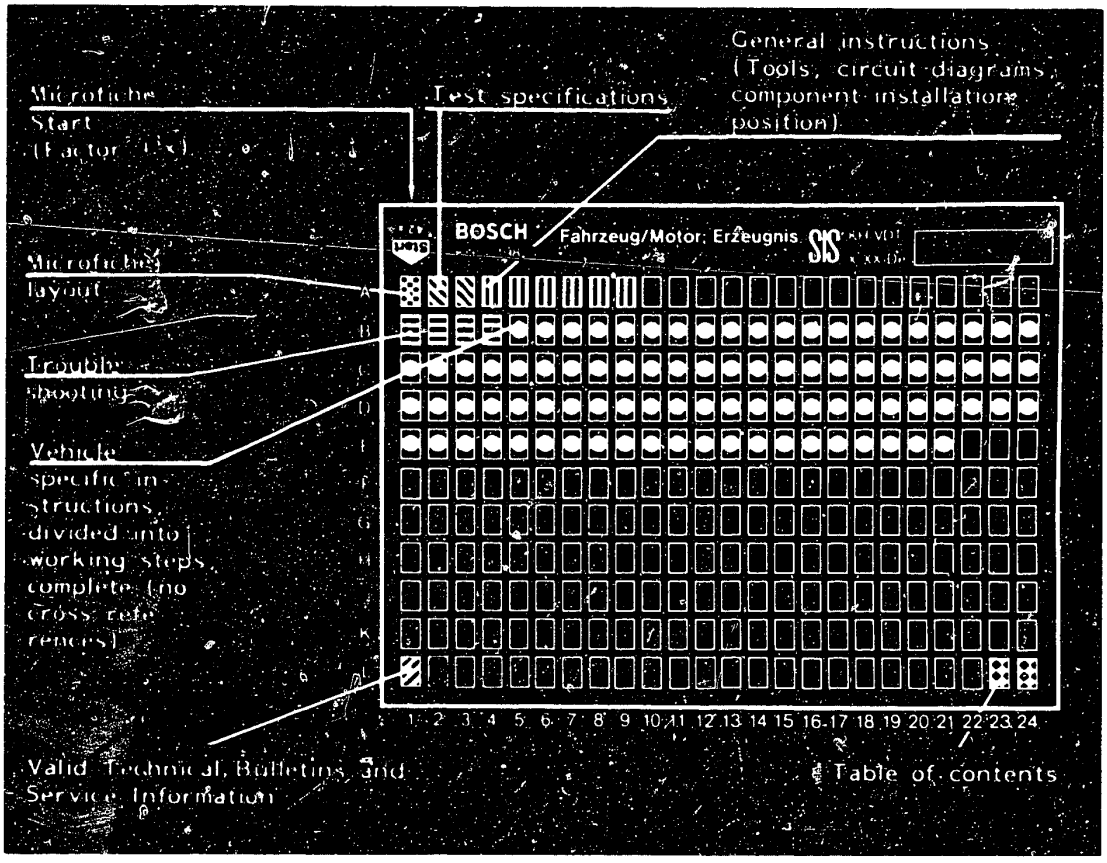
## Structure of microfiche




1. Read from left to right

2. Title of microfiche (appears on each coordinate)

| | | |
|---|---|---|
| **E16** | Product/assembly/test step<br>Vehicle/engine | |

Coordinate

3. Limits of section

Beginning | Mid-section | End | One-page section

4. Purely vehicle-related passages identified by a vertical bar.

5. References to relevant test steps in test specifications; coordinate e.g. C6

**C6**

| | | |
|---|---|---|
| **A1** | Trouble-shooting program | ⬇ |

# 1. Test specifications

1.1 Idle speed: $825 \pm 25\ min^{-1}$ **C5**

1.2 Nozzle-opening pressure: 130 + 8 bar **C6**

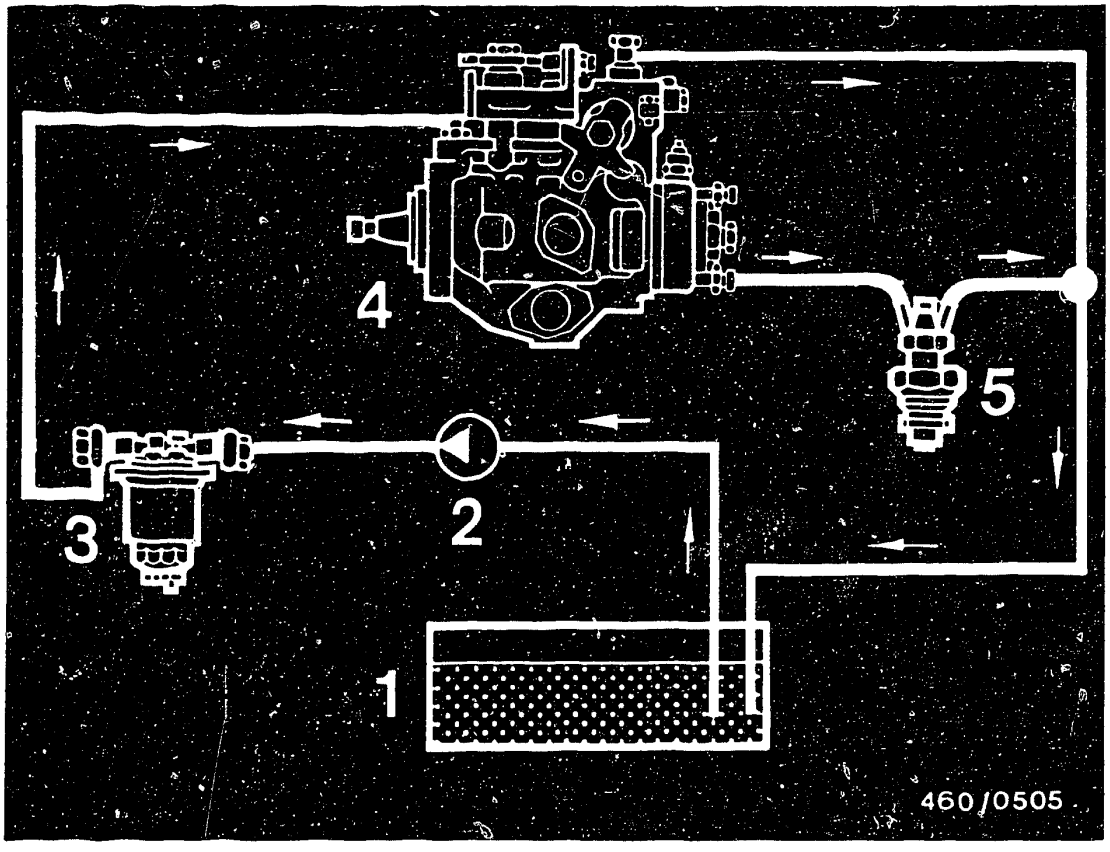
1.3 Filter test **C10**
max. permissible pressure difference:
0.3 bar

1.4 Compression loss: max. permissible 25 % **D5**

1.5 Injection timing: **E19**
Engine position: TDC on cylinder 1
Pump position: 1,0 mm ABDC

## 1.6 Tightening Torques

| | |
|---|---|
| Fuel-injection pump gear | 49 Nm |
| Fuel lines | 25 Nm |
| Fuel-injection pump fastening screws | 29 Nm |
| Fuel-injection pump support bracket | 29 Nm |
| Screw plug | 15 Nm |
| Nozzle-holder assembly fastening screws | |
| Ritmo 10.79 . 10.82 | 39 Nm |
| Ritmo as of 10.82 | 49 Nm |
| Sheathed-element glow plugs | 15 Nm |
| Belt tensioning roller fastening nut | 44 Nm |

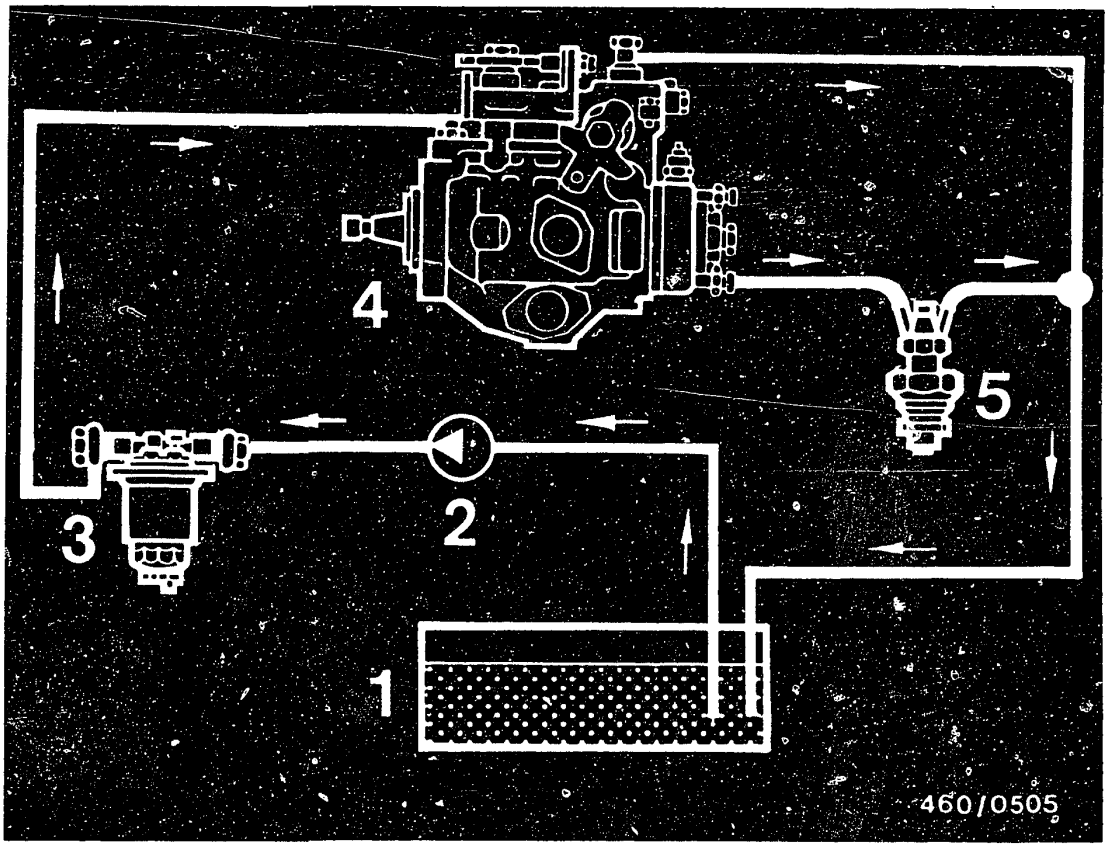



1 = Fuel tank
2 = Fuel pre-supply pump (only on export models)
3 = Fuel filter
4 = Distributor-type injection pump
5 = Injection nozzles

## 2. Connection diagram of fuel lines

The fuel lines are connected as shown in the above diagram.

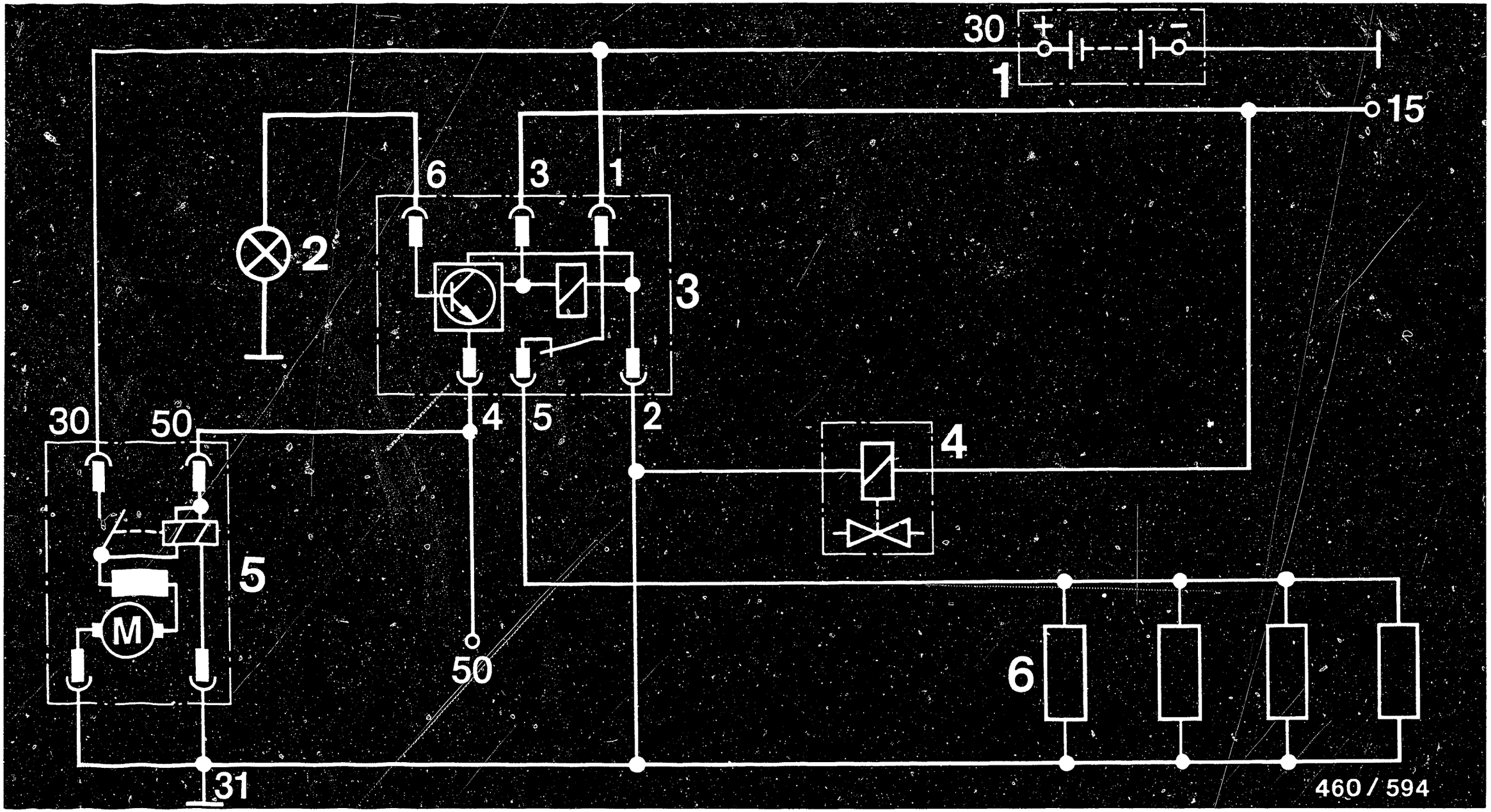
The fuel flows in the direction of the arrows.




1 = Differential-pressure gauge
2 = Filter outlet
(use inlet union and extra-long inlet-union screw 2 443 456 020)
3 = Filter inlet (use inlet union and extra-long inlet-union screw 2 443 456 020)

## 2.1 Connection diagram for filter test

Connect differential-pressure gauge to fuel filter using appropriate connecting pieces.




1 = Battery
2 = Preheating indicator lamp
3 = Glow-duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Glow plugs

3. Terminal diagram for preheating system


A6 | Terminal diagram - preheating system | Fiat Ritmo Diesel | →

A7 | Terminal diagram - preheating system | Fiat Ritmo Diesel | ←

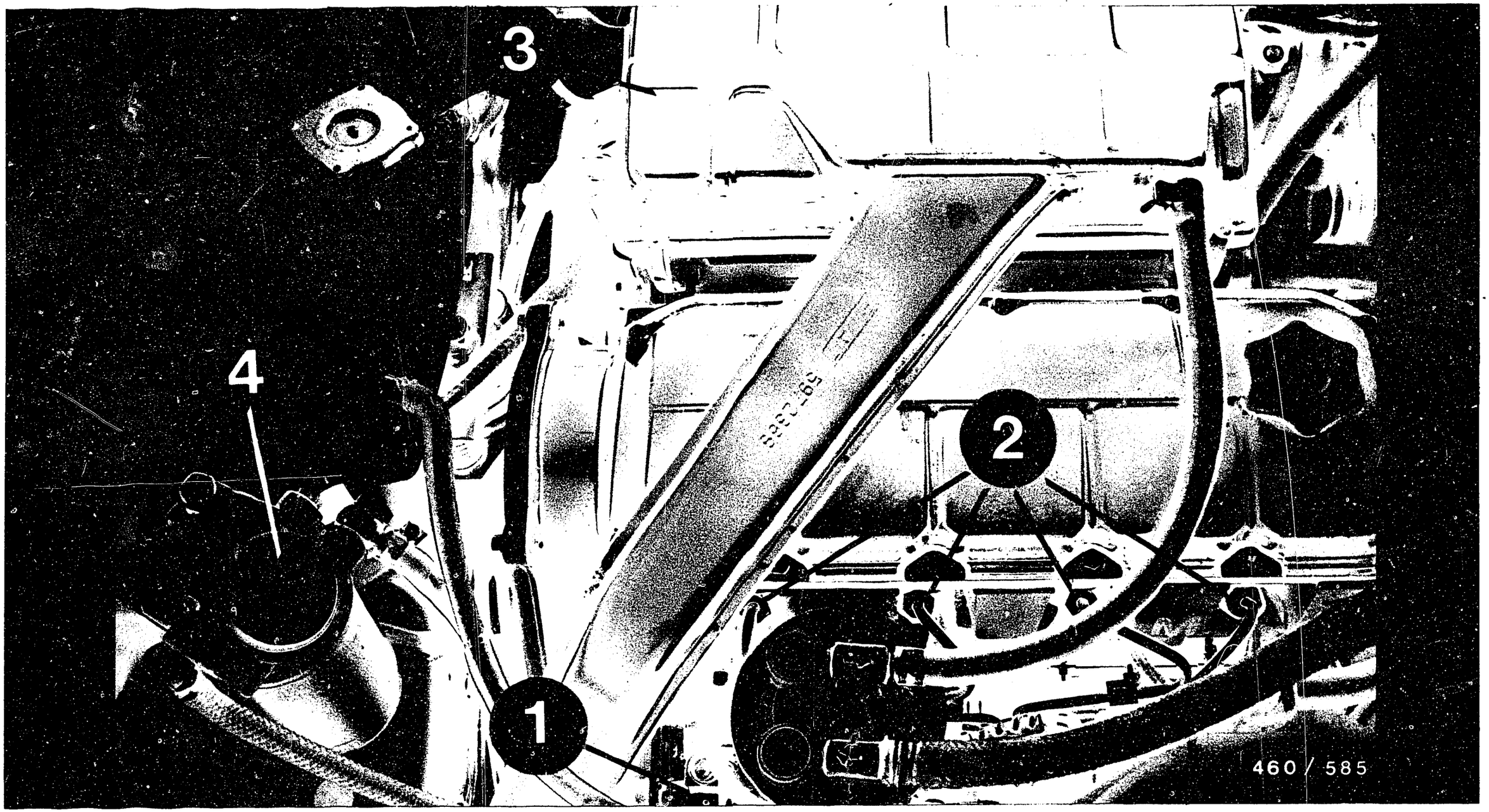
## 4. Test equipment and Tools

| Designation | Part no. | Use |
|---|---|---|
| Puller* | Fiat tool<br>A 42 128 | Removing injection pump gear |
| Holding device*<br>Part-piece | Fiat tool<br>A 60 473<br>A 60 473/10 | Locking injection pump gear |
| Tensioner* | Fiat Tool<br>A 60 722 | Setting toothed-belt tension |
| Box wrench | KDEP 1115 | Loosening/Tightening fuel-injection tubing |
| Measuring tool | KDEP 1085 | Injection timing |
| Mini dial indicator 1/100 mm divisions | Commercially available e.g. Hahn & Kolb 7000 Stuttgart Part no. 33003 with adaptor KDEP 1127 | Injection timing |

* Buy tool from local Fiat agent.

## Test equipment and Tools (continued)

| Designation | Part no. | Use |
|---|---|---|
| Nozzle tester | EFEP 60 H<br>0 681 200 502 | Testing the injection nozzles |
| Compression tester | Commercially available | Testing the engine compression |
| Compression-loss tester | EFAW 210 A<br>0 681 001 901 | Testing the engine compression loss |
| Tachometer | Commercially available | Setting the engine speed |
| Differential pressure gauge | Commercially available<br>Part no.<br>NG 160/311-911/<br>-1.0 + 4.0 bar<br>Firma Henni<br>Nauheimer Str.<br>78 - 80<br>7000 Stuttgart 50 | Filter test |
| Smoke tester | 0 681 169 039<br>0 681 169 038 | Smoke test |




1 = Injection pump  2 = Injection nozzles  3 = Air filter  4 = Fuel filter

5. Installation position of components in Fiat Ritmo Diesel

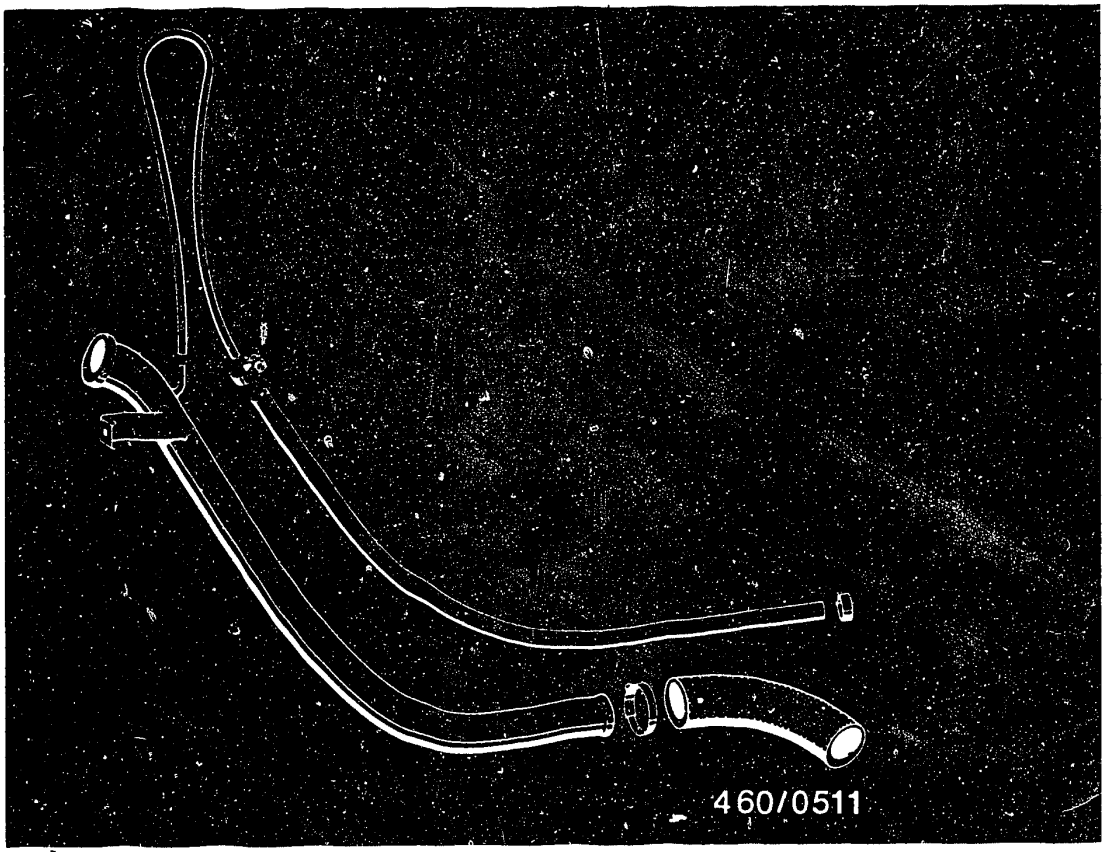
## 6. Trouble-shooting

Customer complaint (symptom)

| 1. Engine fails to start or starts only with great difficulty when warm. | 2. Engine fails to start or starts only with great difficulty when cold. | 3. Engine hunts when idling. | 4. Erratic idling when engine is warm. | 5. Engine misses during vehicle operation. | 6. Unsatisfactory performance. | Cause (component fault) | Coordinate |
|---|---|---|---|---|---|---|---|
| ● | ● | | | ● | ● | Tank empty; tank vent clogged | B 5 |
| | ● | | ● | | | Injection sequence does not correspond to firing sequence | B 6 |
| | | | | ● | | Overflow restriction clogged | B 7 |
| ● | ● | | | | | Shutoff device defective | B 8 |
| | | ● | | ● | ● | Inlet-union screws of inlet and return lines clogged | B 12 |
| ● | ● | | ● | ● | ● | Air in fuel system | B 13 |
| | ● | | | | | Heavy paraffin deposits in filter | B 15 |
| ● | ● | | | ● | ● | Connections loose; lines leaky or broken | B 18 |
| ● | ● | | | ● | ● | Supply lines clogged | B 20 |
| ● | ● | | | ● | ● | Fuel-injection tubing clogged or constricted | B 20 |
| | | | | | ● | Engine air filter clogged | C 1 |
| | | | ● | | | Idle speed incorrect | C 5 |
| ● | ● | | ● | | ● | Injection nozzle defective | C 6 |
| | ● | | ● | | ● | Start of pump delivery incorrect | E 19 |
| ● | ● | | | ● | ● | Fuel filter clogged | C 10 |
| | ● | | | | | Pre-heating system defective | C 13 |
| | | | | | ● | Timing device defective | C 24 |
| | ● | | ● | | | Engine compression poor or uneven | D 1 |
| | | | | | ● | Maximum speed incorrectly adjusted | D 11 |
| ● | ● | ● | ● | ● | ● | Fuel-injection pump (governor) defective or out of adjustment | D 11 |

Trouble-shooting (continued)

| 7. Excessive fuel consumption. | 8. Engine cannot be switched off. | 9. Engine runs rough, black smoke in full-load range; possibly lack of power. | 10. Fog-like smoke in full-load range (white). | 11. Incorrect engine speeds. | 12. Engine will not rev up when cold. | 13. Distributor-type fuel-injection pump becomes too hot. | Cause (component fault) | Coordinate |
|---|---|---|---|---|---|---|---|---|
| | | | ● | | ● | | Tank empty; tank vent clogged | B 5 |
| | | ● | | ● | ● | | Injection sequence does not correspond to firing sequence | B 6 |
| | | | | | | ● | Overflow restriction clogged | B 7 |
| | ● | | | | | | Shutoff device defective | B 8 |
| | | | ● | ● | ● | | Inlet-union screws of inlet and return lines clogged | B 12 |
| | | | ● | | ● | | Air in fuel system | B 13 |
| | | | | | ● | | Heavy paraffin deposits in filter | B 15 |
| ● | | | | | | | Connections loose; lines leaky or broken | B 18 |
| | | | ● | | ● | | Supply lines clogged | B 20 |
| | | | ● | | ● | | Fuel-injection tubing clogged or constricted | B 20 |
| | | ● | | | | | Engine air filter clogged | C 4 |
| | | | | ● | | | Idle speed incorrect | C 5 |
| | | ● | | | | | Injection nozzle defective | C 6 |
| ● | | ● | ● | | ● | | Start of pump delivery incorrect | E 19 |
| | | | ● | | ● | | Fuel filter clogged | C 10 |
| | | | | | | | Pre-heating system defective | C 13 |
| | | ● | ● | | | | Timing device defective | C 24 |
| ● | | | | | ● | | Engine compression poor or uneven | D 1 |
| | | | | ● | | | Maximum speed incorrectly adjusted | D 11 |
| ● | ● | ● | ● | ● | ● | ● | Fuel-injection pump (governor) defective or out of adjustment | D 11 |

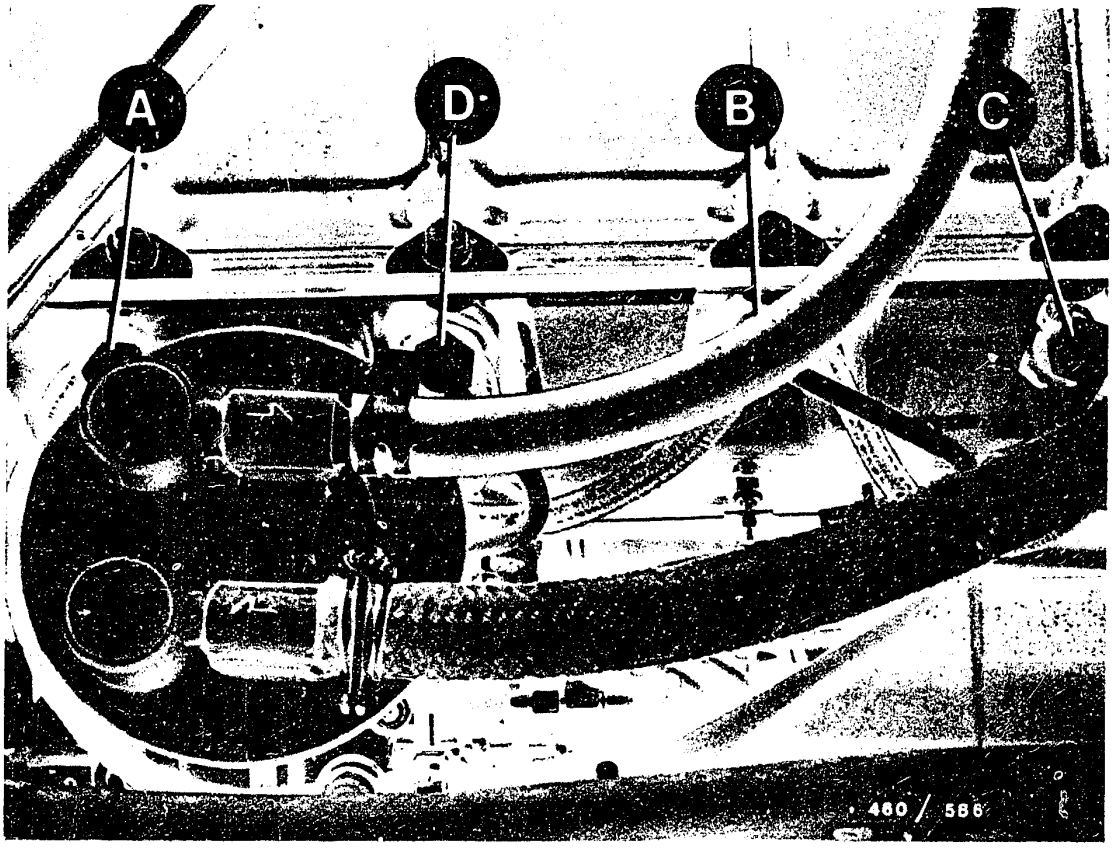



## 7. Check tank vent

Open filler cap.
If the fault disappears after opening the filler cap, the tank vent is defective.

Remove tank vent hose lines (picture) and check for clogging and constriction.

If necessary, check fitting on tank.

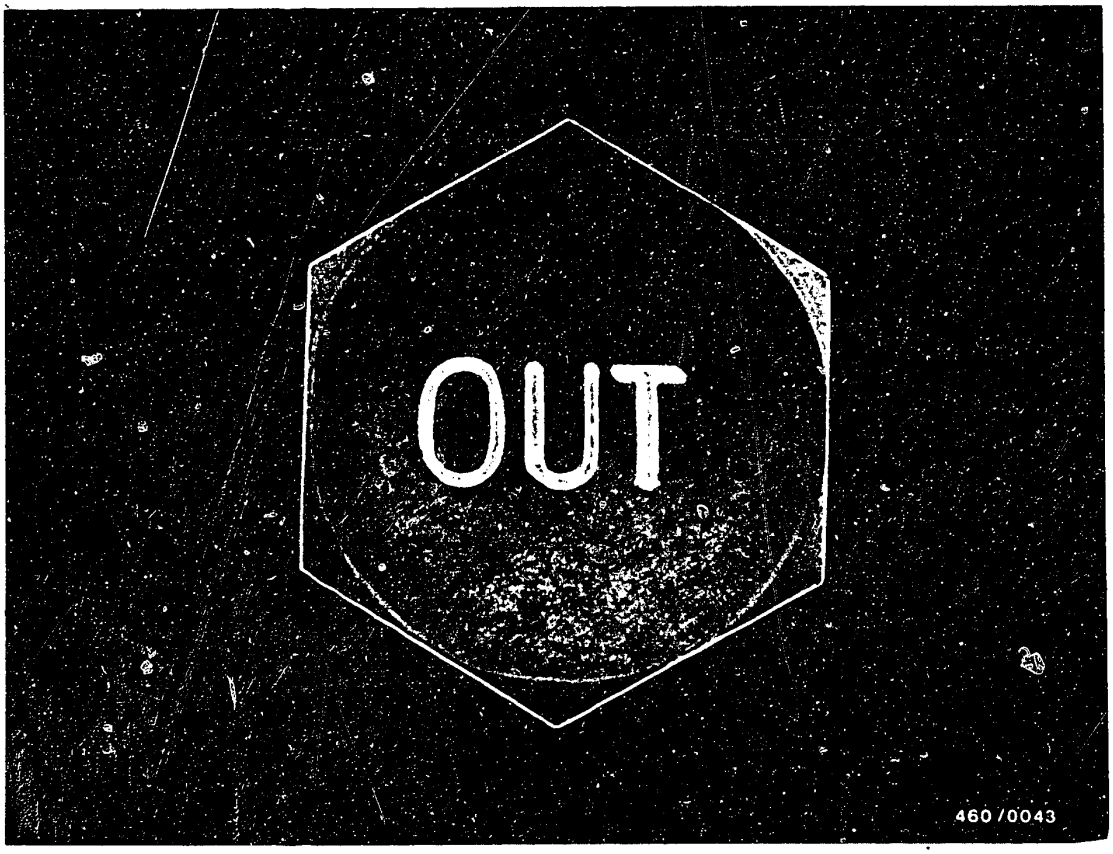



## 8. Check routing of fuel-injection tubing

The individual fuel-injection lines are held together by clamps so that it is impossible for the outlets to be mixed up.

If, however, there is any doubt, check the routing of the lines as shown in the picture above.

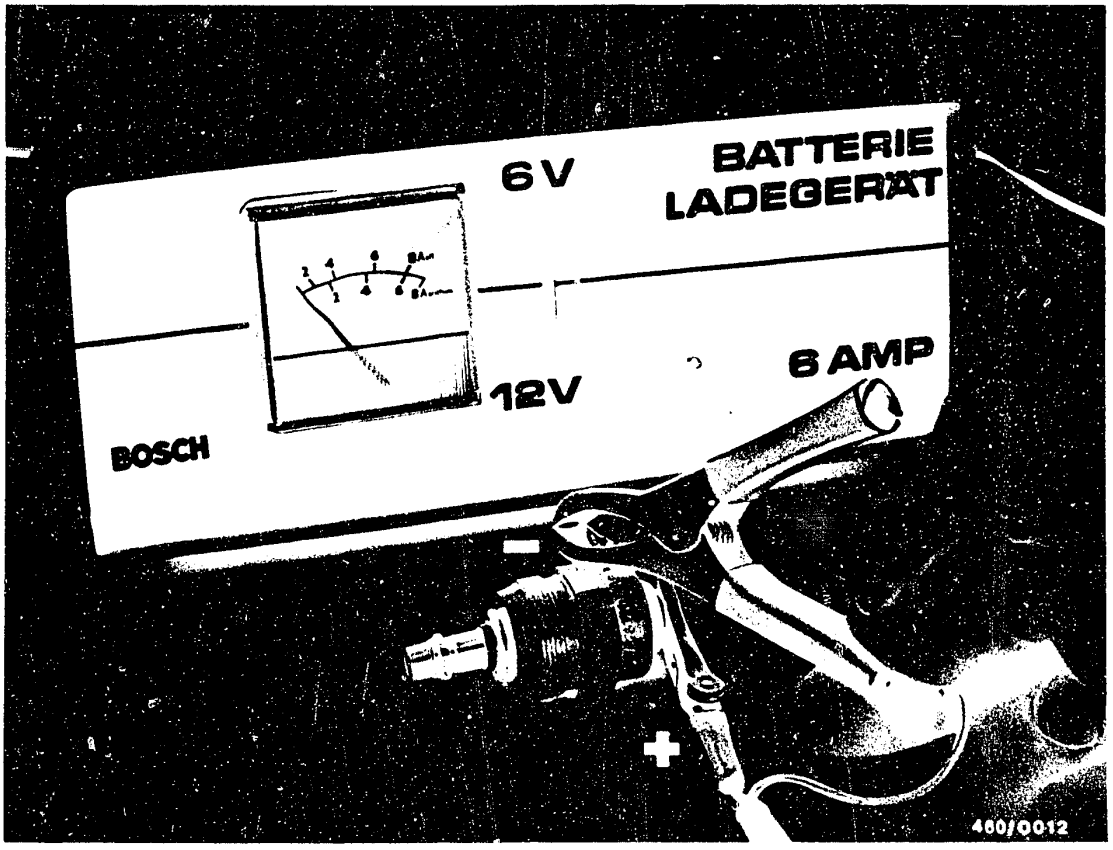
The pairing of the fuel-injection pump outlets with the individual engine cylinders is identified by the letters A...D (picture)




## 9. Check overflow restriction

Unscrew overflow restriction on fuel-injection pump (marked "out").

Perform visual inspection of wire screen for impurities. If in doubt, replace overflow restriction.



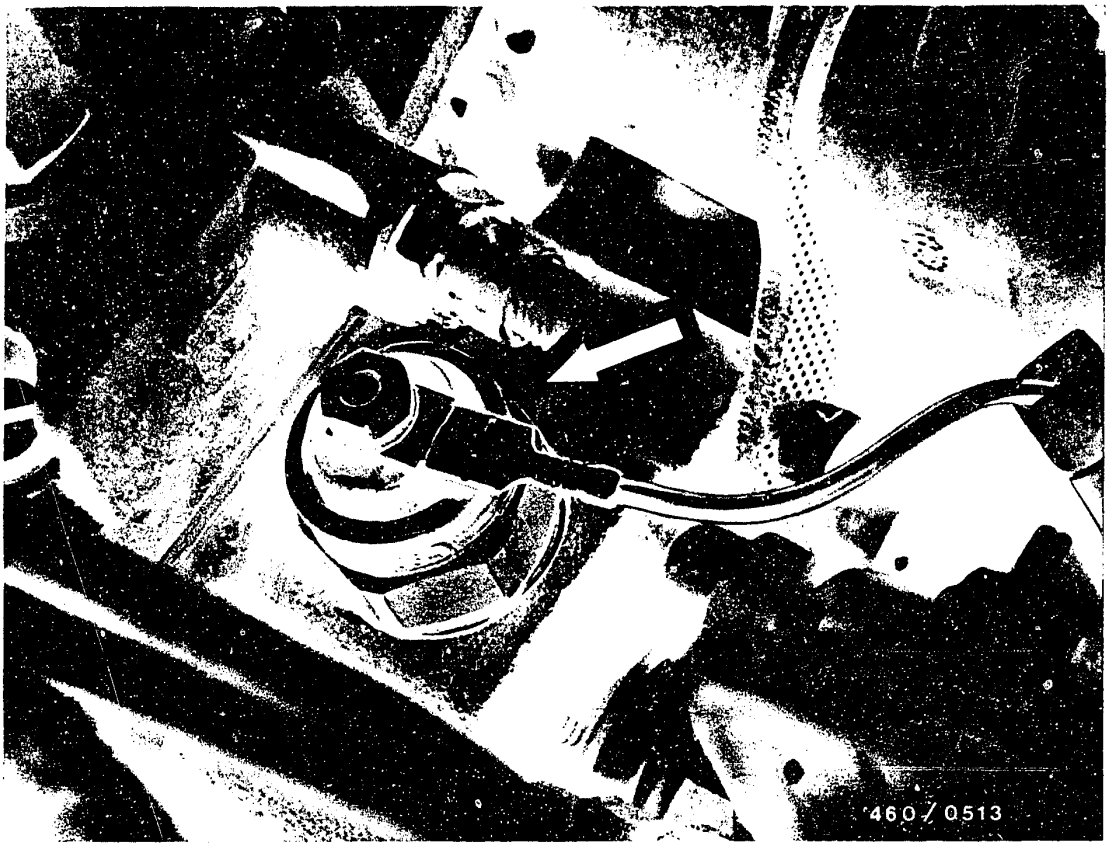

10. Check operation of shutoff device

10.1 Engine fails to start

Check whether solenoid-operated valve is supplied with voltage (min. 10 V) with glow-plug and starter switch switched on (drive position).
If voltage is present, remove fuel-injection tubing and take out solenoid-operated valve.
Cleanliness is essential.

When removed, check operation of solenoid-operated valve.

Note:
When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.

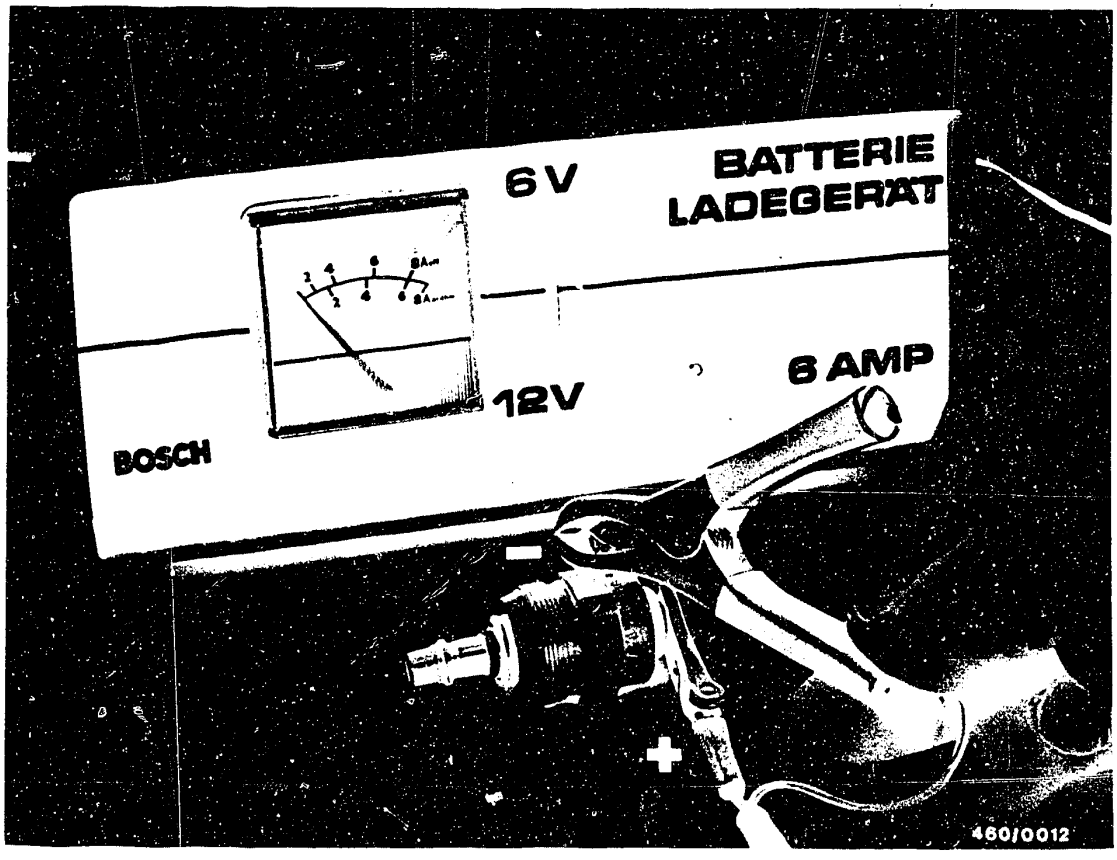



## 10.2 Engine can not be switched off

With the glow-plug and starter switch in the stop position there must be no voltage across the solenoid-operated valve, i.e. the fuel inlet to the distributor-pump plunger is interrupted.

If the engine runs on, although there is no voltage across the solenoid-operated valve, the engine can be switched off as follows:

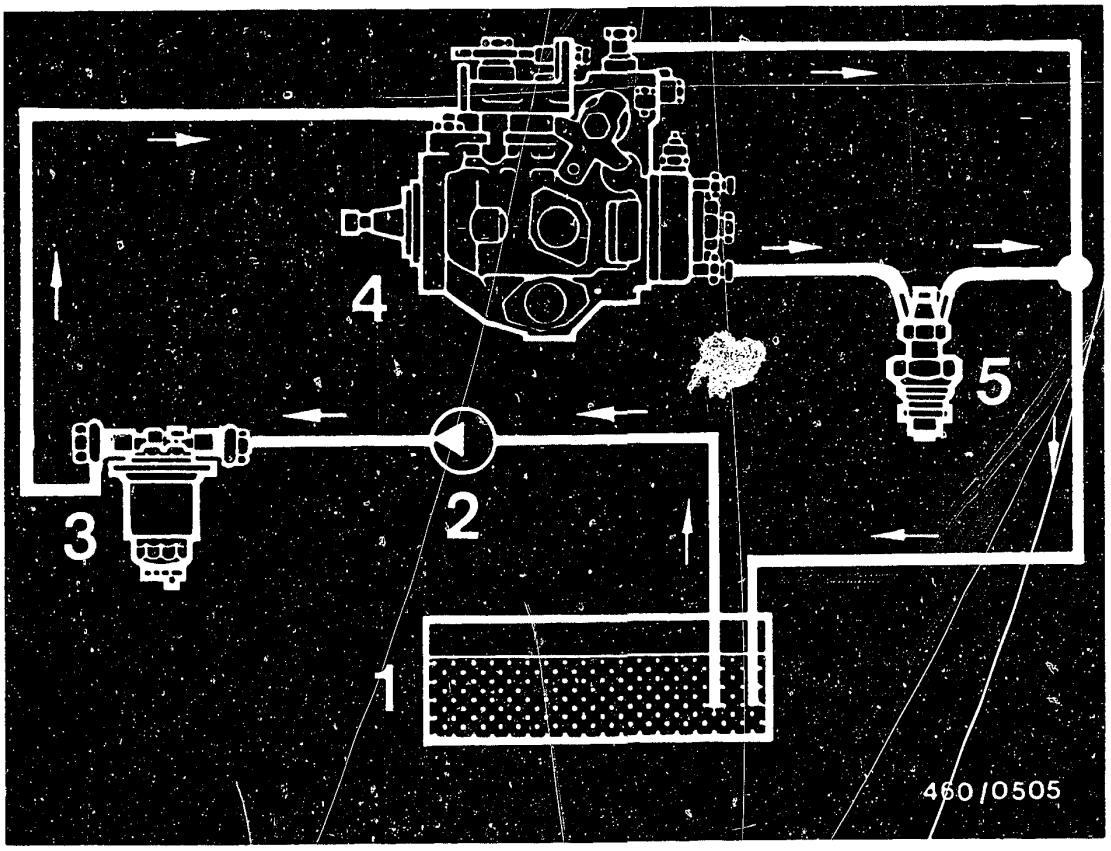
Select 3rd or 4th gear.
Jam on footbrake and
let out the clutch




## 10.2.1 Solenoid-operated valve test

Remove fuel-injection tubing.
Take out solenoid-operated valve.
Cleanliness is essential.
When removed, check operation of solenoid-operated valve.

Note:
When removed, the solenoid-operated valve must only be supplied with voltage for a short period of time since it is no longer being cooled by the fuel.
Check valve seat in hydraulic head (visual inspection).

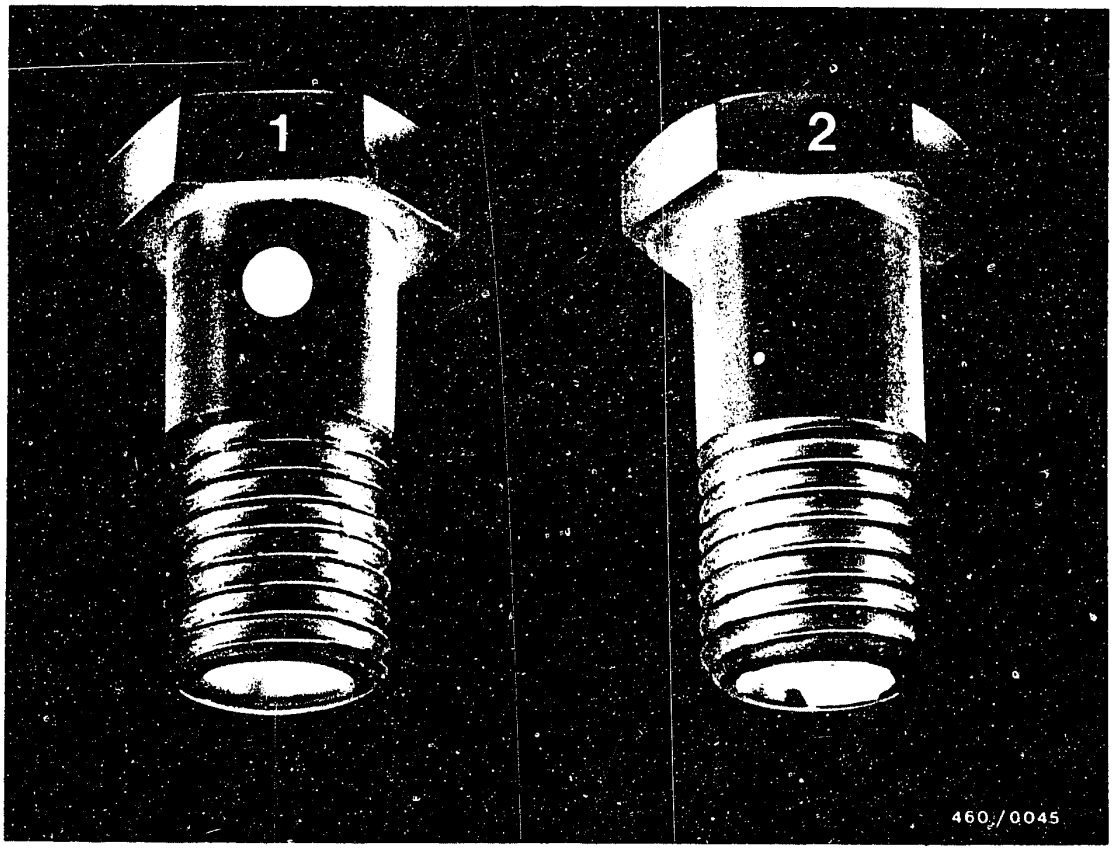



1 = Fuel tank
2 = Fuel pre-supply pump (only on export models)
3 = Fuel filter
4 = Distributor-type injection pump
5 = Injection nozzles

## 11. Diagram of fuel lines

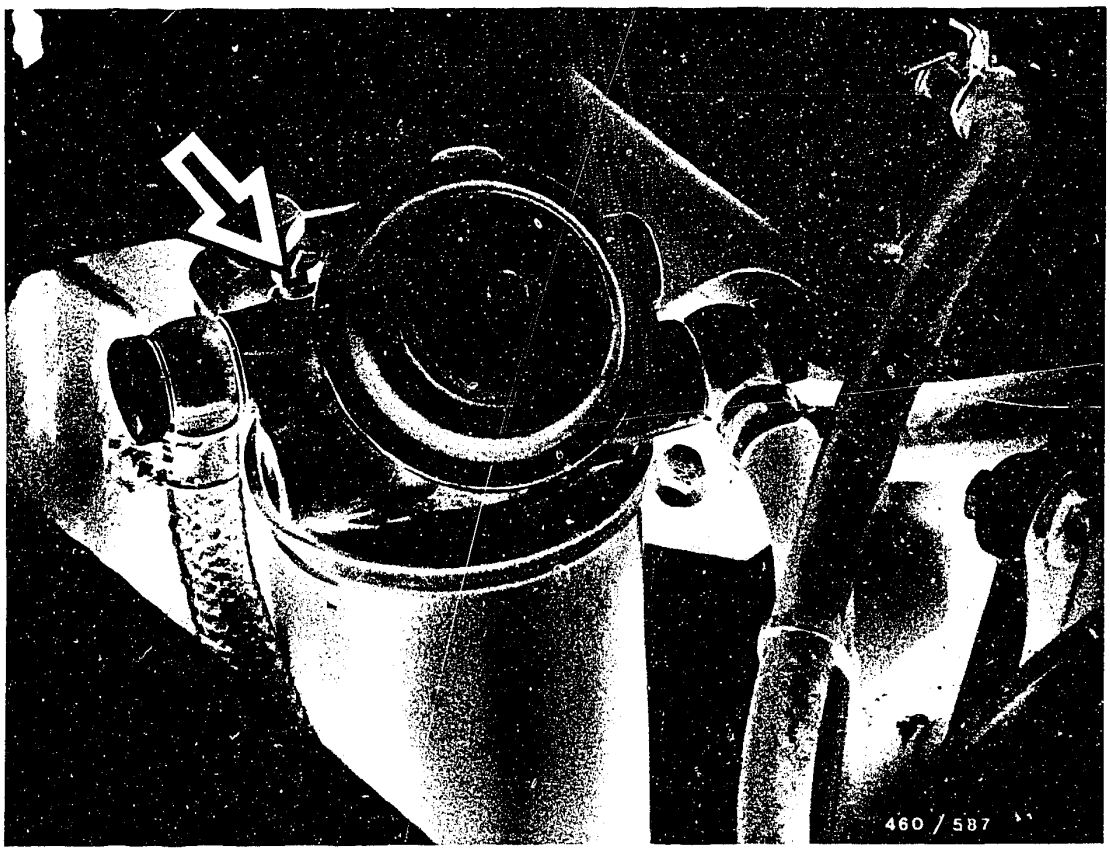
The fuel lines are connected as shown in the above diagram.

The fuel flows in the direction of the arrows.




As regards the connections to the fuel-injection pump, ensure that the inlet-union screw for fuel inlet (1) and the throttle screw for fuel return (2) are not mixed up.

The throttle screw is located on the cover of the fuel-injection pump and the head of the screw is marked with the word "out".



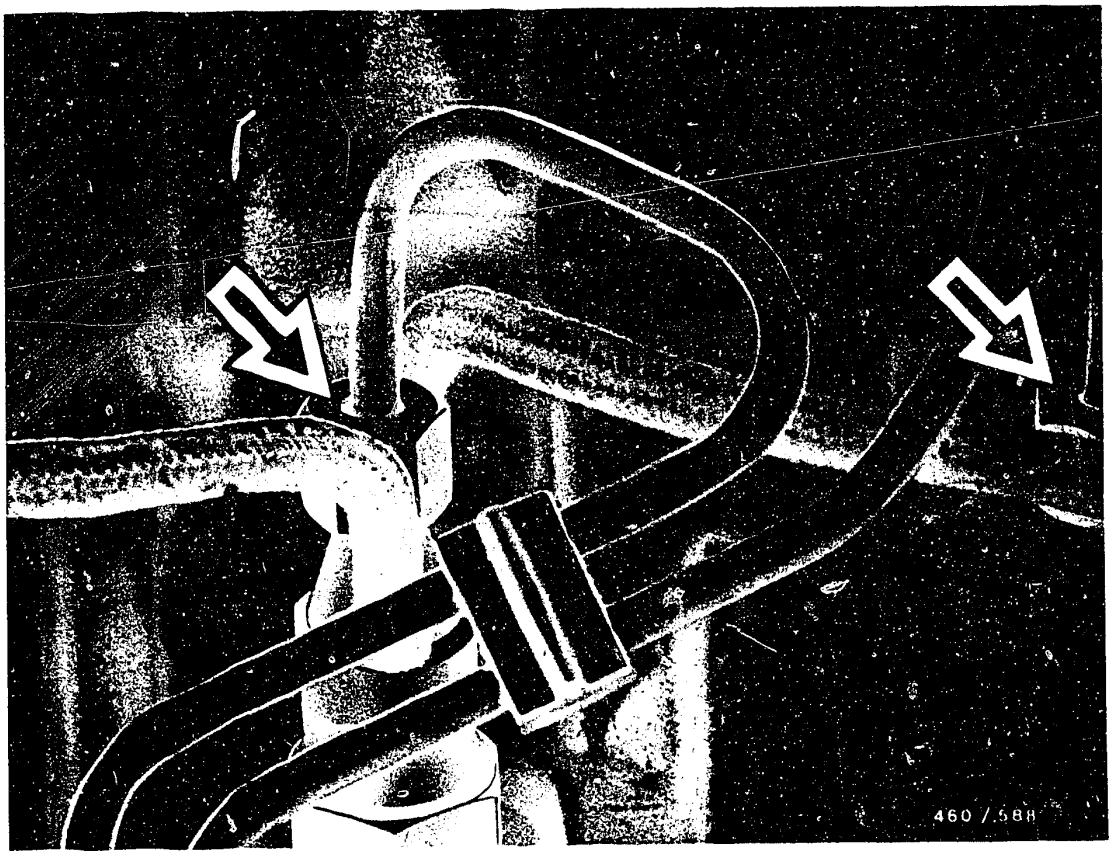

## 12. Bleed fuel system

Loosen bleeder screw on fuel filter (arrow).

Operate hand primer on fuel filter until fuel escaping from the bleeder screw is free of bubbles.

Tighten bleeder screw.

Continue to operate hand primer until resistance can be felt.



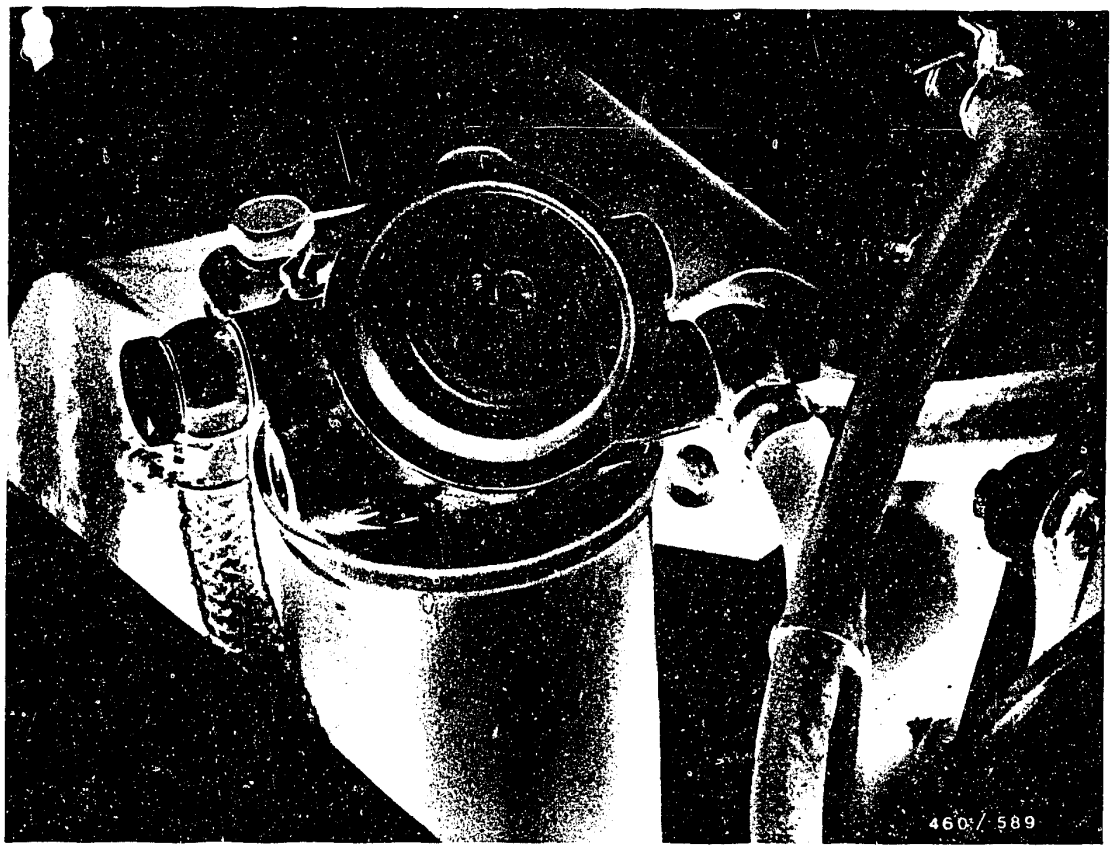

Loosen union nuts of fuel-injection tubing on nozzle-holder assemblies.

Actuate starting motor without preheating. When the fuel escaping from the bleeder hole of the injection pump is free of bubbles, tighten bleeder screw.

Continue to operate starting motor until fuel escapes from union nuts of nozzle-holder assemblies (arrows).

Tighten union nuts.

Actuate starting motor until engine starts.



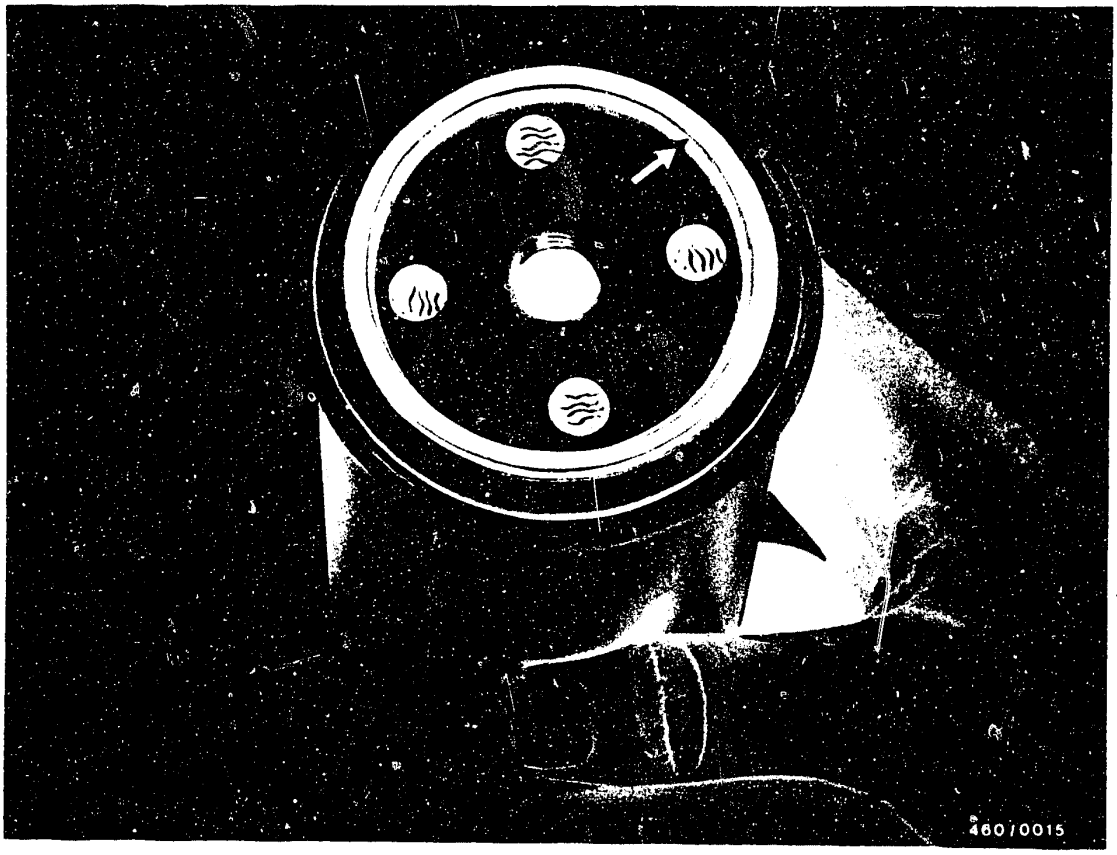

## 13. Replace and drain water from filter box

### 13.1 Replace filter box

Unscrew fuel filter from the filter cover.

If stuck, loosen filter box with special wrench, e.g. Matra W 167.

Catch escaping fuel.

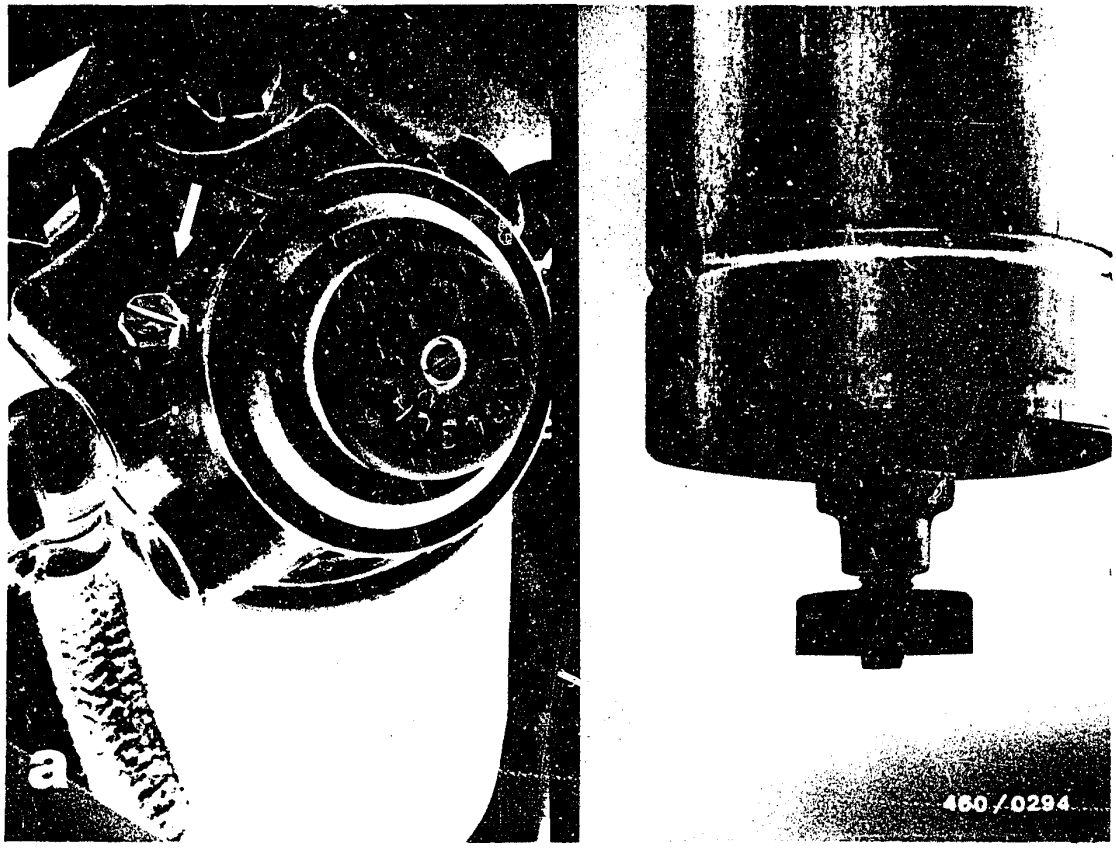



Rub diesel fuel into the rubber seal (arrow) of the new filter box.

Screw the filter box into the cover by hand and tighten.

Check the fuel filter for leaks.

In the case of winter fuel it may be necessary to add petroleum as specified by the vehicle manufacturer.

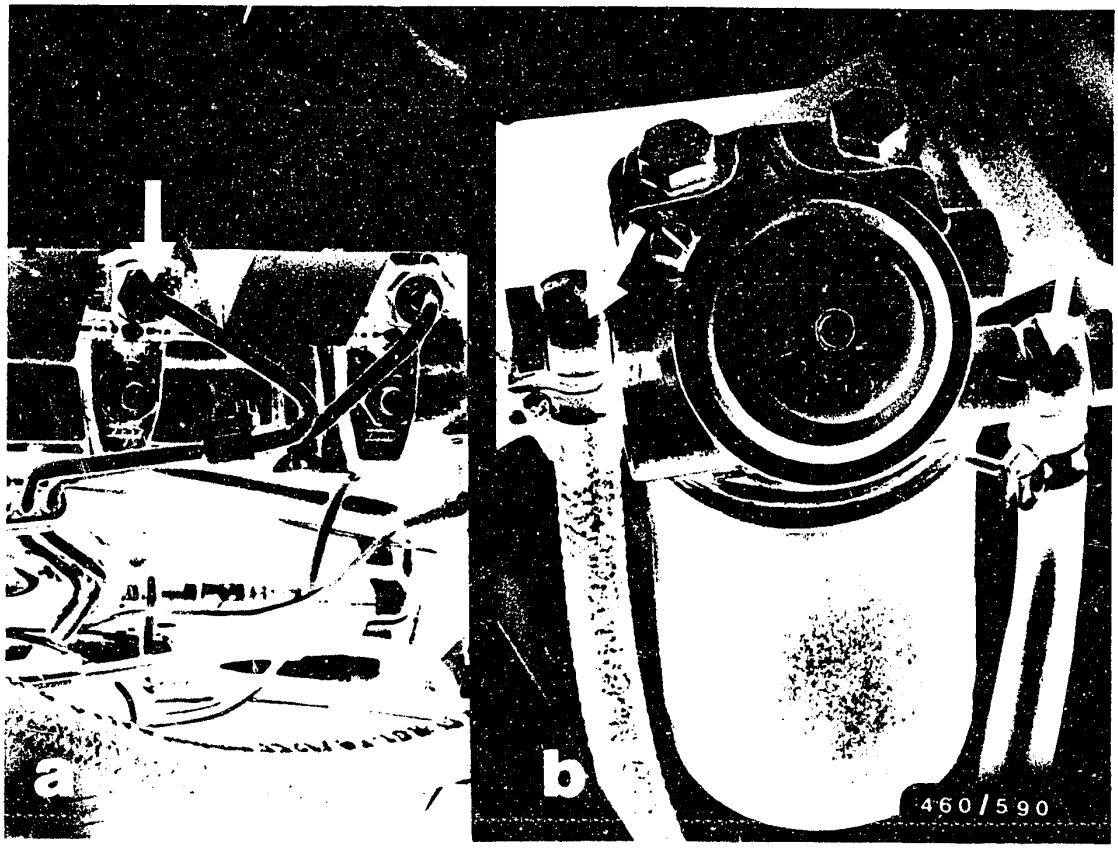



13.2 Drain water from fuel filter

Loosen bleeder screw (arrow) on the filter cover by a few turns (Fig. a).

Loosen water-drain screw on the base of the filter and drain approx. 100 $cm^3$ of liquid into collecting vessel (Fig. b).

Tighten water-drain screw and bleeder screw and check for leaks. If necessary, reconnect leak-off hose on nozzle-holder assembly.

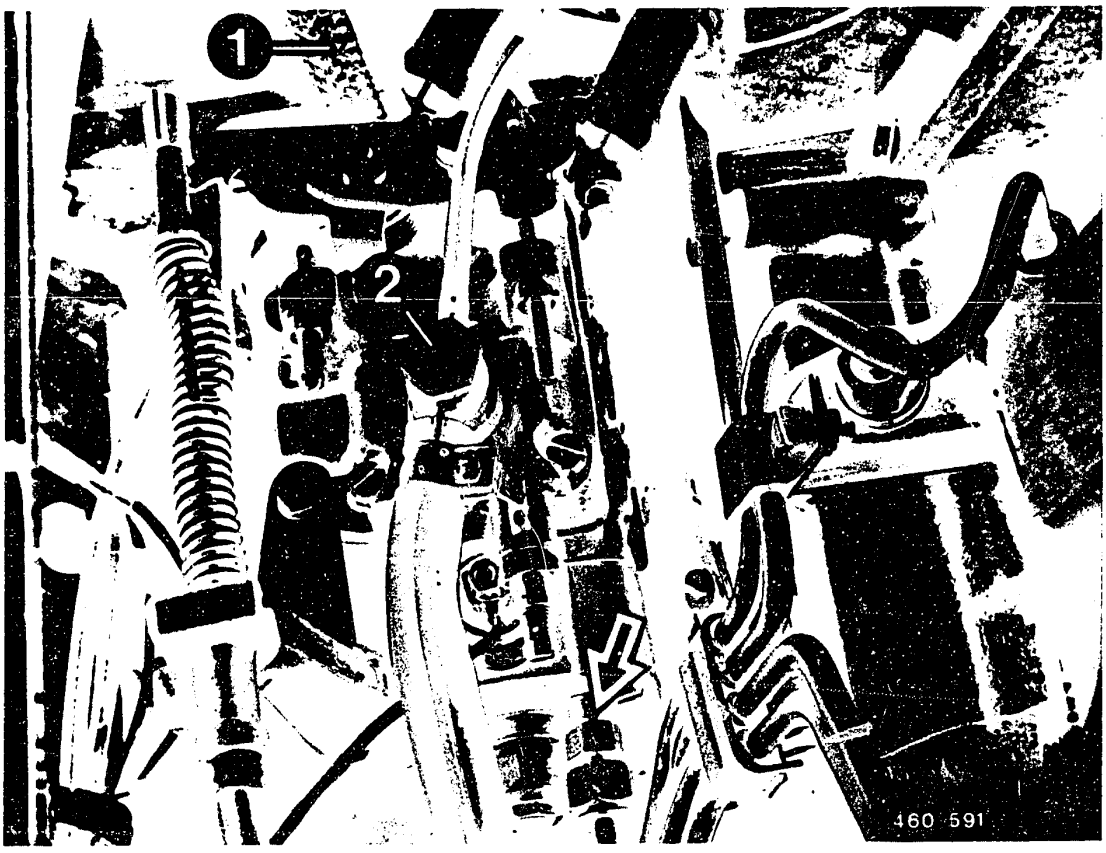



## 14. Check fuel-injection system for leaks

Perform leak test with engine at normal operating temperature.

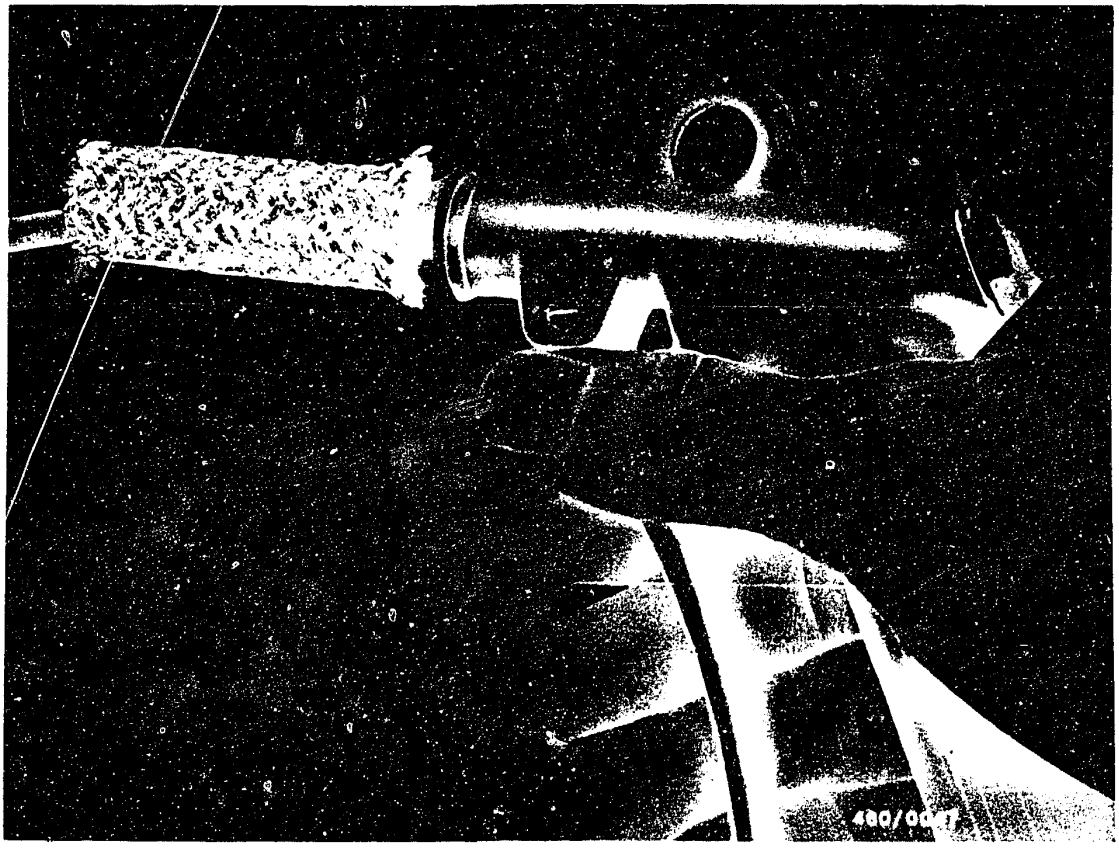
Check all fuel line connecting points. Pay particular attention to:

- Connections on nozzle-holder assemblies (Fig. a - arrow)
- Connections on fuel filter (Fig. b - arrows).




- Inlet (1) and return lines (2) on distributor-type fuel-injection pump
- Delivery-valve holders on hydraulic head (arrow).

Check fuel lines for hairline cracks.



15. Check fuel lines

Subject suspect fuel lines to a visual inspection.

If there is no detectable pinching or kinking, the fuel line in question must be removed.

Check fuel line for throughflow using compressed air and clean if necessary.

A suitable hose piece may be used as a side seal for blowing out the fuel lines.

## 16. Smoke test - check air filter

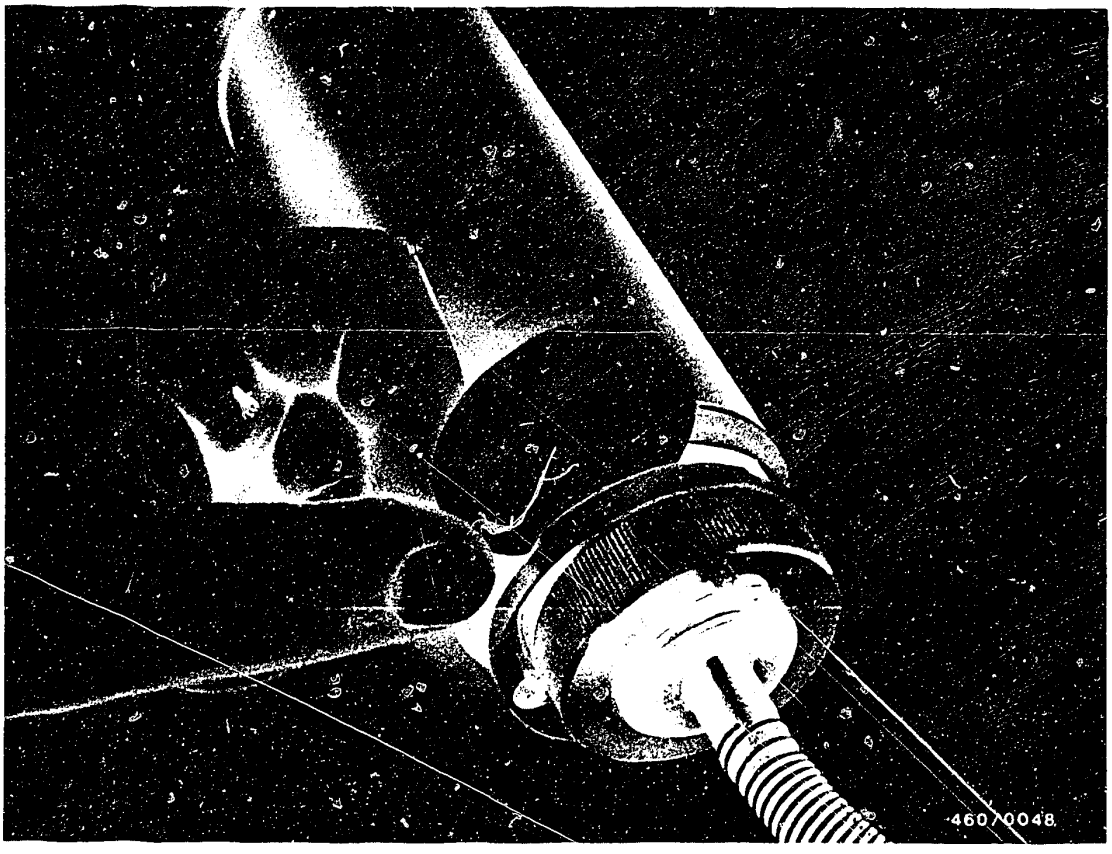
### 16.1 Smoke test

Summary of the contents of the legal regulations (as at April 1978). Applicable to Federal Republic of Germany.

This regulation applies only to the homologation of motor vehicles having at least 4 wheels with a maximum permissible speed of more than 25 km/h. A smoke emission test is not prescribed for official general inspections.

Parts which may have an influence on environmental pollution must be designed in such a way that the legal requirements are met during operation and despite vehicle vibration.

This applies in particular to cold-start devices and full-load stops. The Rheinland-Westfälische TOV (Technical Inspection Bureau of Rhineland-Westfalia) in Essen is the sole approval agency.

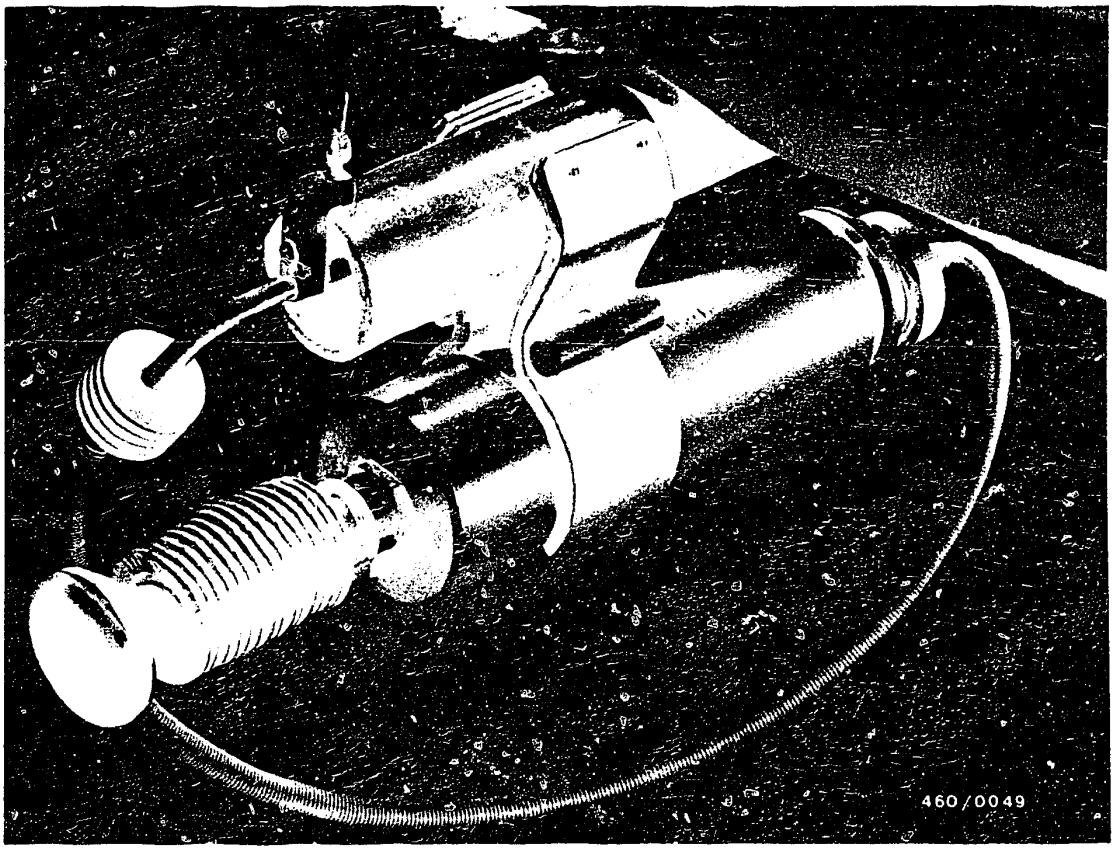



## 16.1.1 Test setup

The smoke test is conducted using the Bosch filter-type smokemeter.
The filter-type smokemeter consists of the following units:

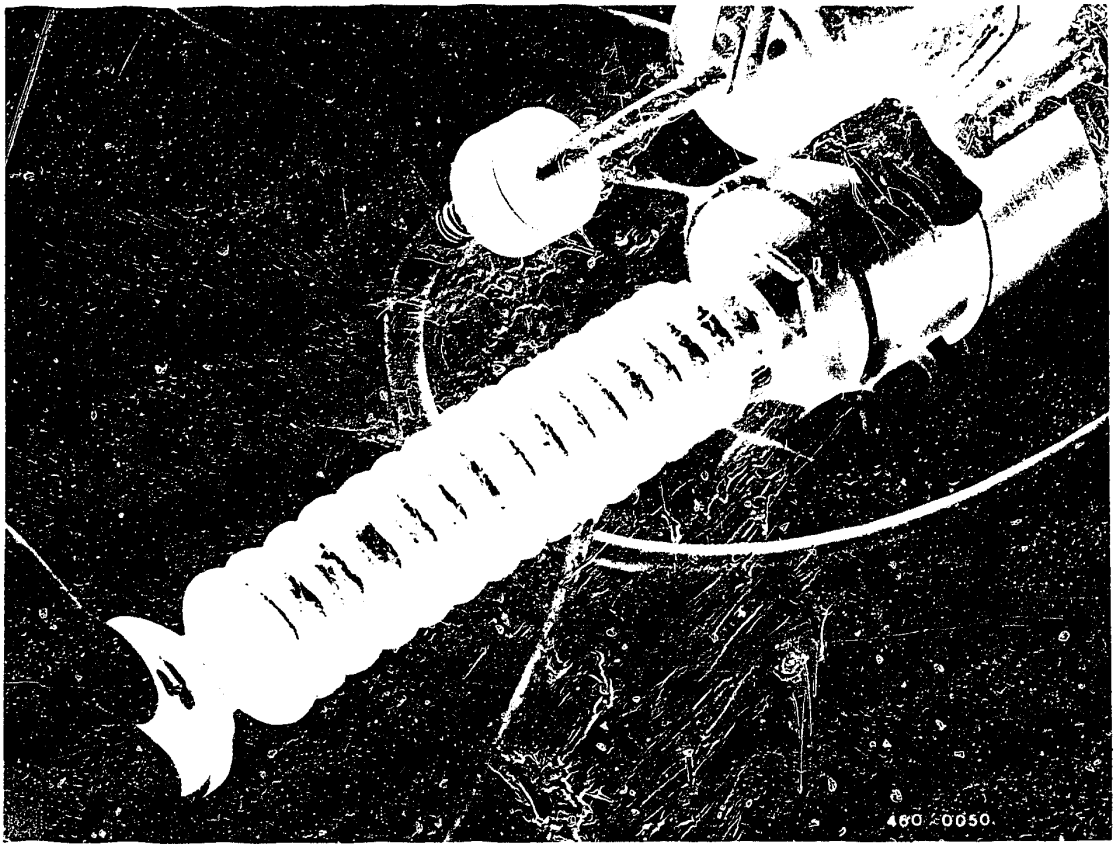
| | |
|---|---|
| Accessories box with proportioning pump | 0 681 169 038 |
| Evaluating unit | 0 681 169 039 |

Insert filter plate into proportioning pump.




Mount sampling pump on exhaust pipe using appropriate clamp.

Introduce exhaust-sample pickup as far as possible into exhaust pipe and clamp in position.

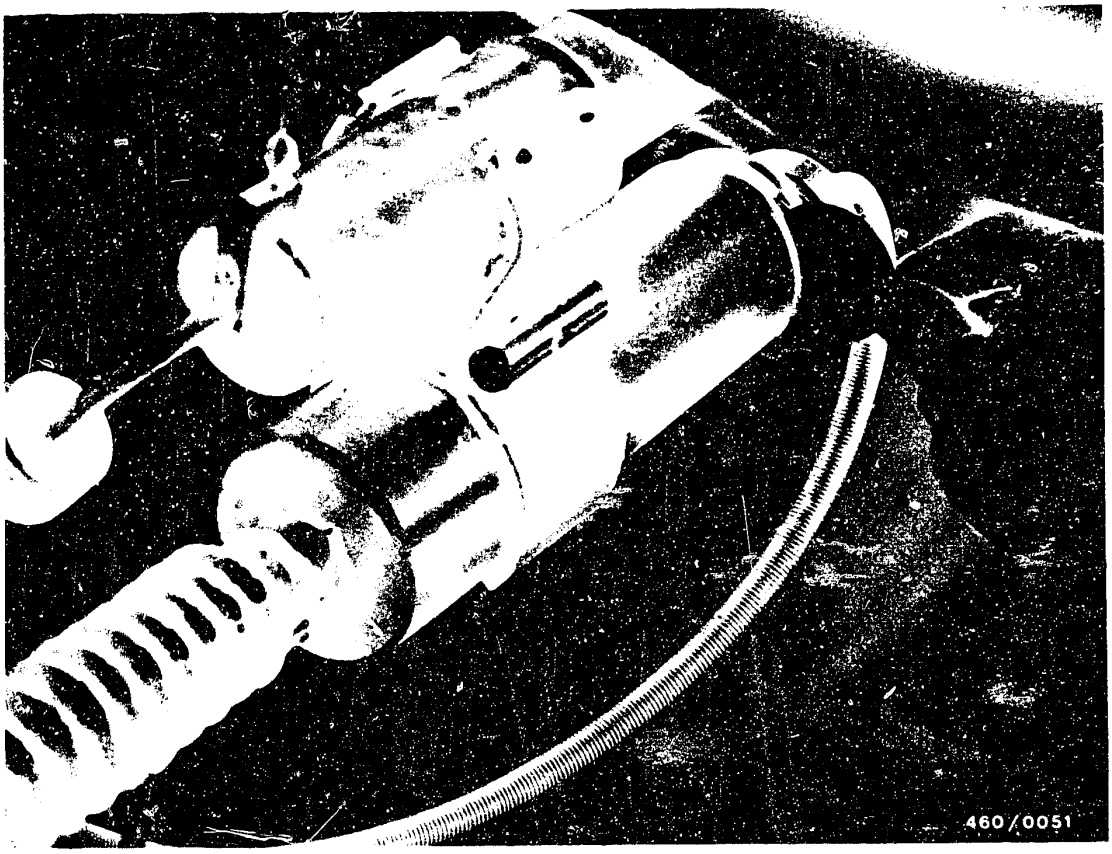



## 16.1.2 Test procedure

Set proportioning pump by pressing in the black push-button.
Take rubber ball on triggering hose and enter passenger compartment.

The test can be performed on the chassis dynamometer or on the road (gradient).

The chassis dynamometer is preferable in any case. Find the gear in which, with the accelerator pedal in the full-load position, a speed of approx. 40 km/h is reached. Load the engine so that, with the accelerator in the same position, a speed of approx. 25 km/h is reached.

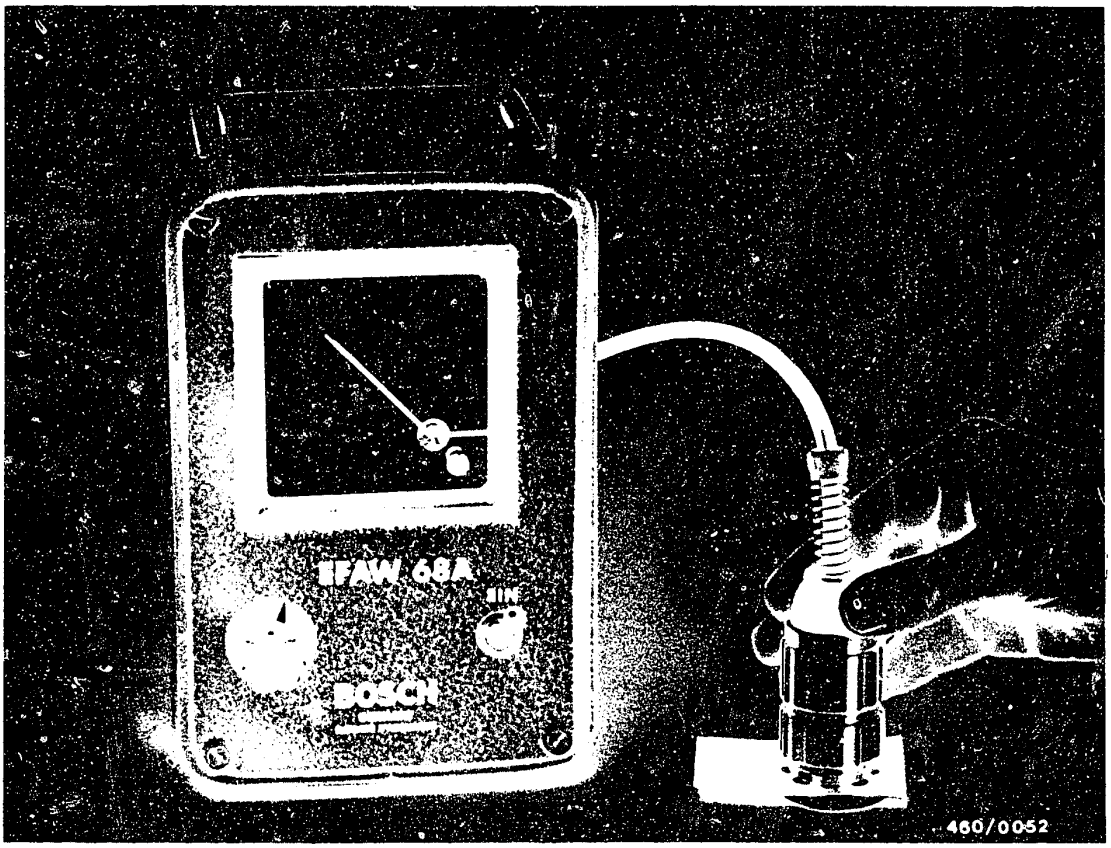



Maintain this load condition for 5 seconds and then trigger the sampling pump by pressing the rubber ball.

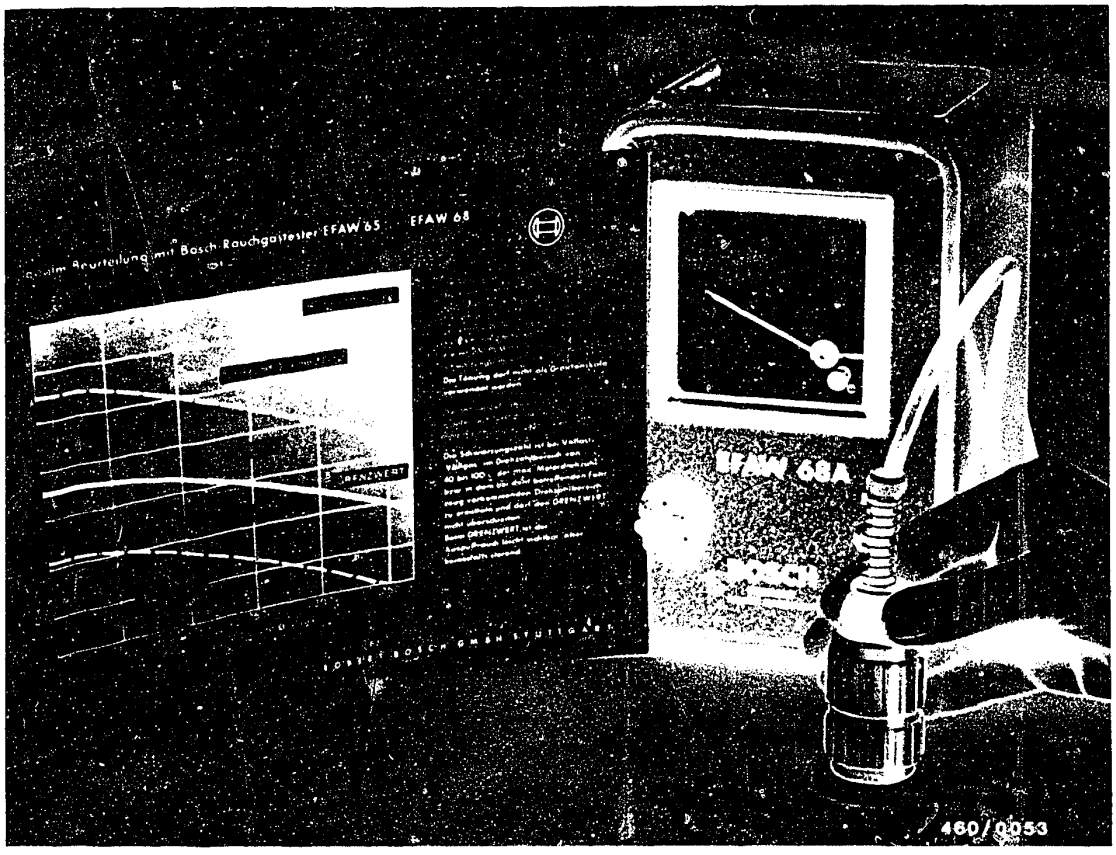
Switch off engine.

Caution!
During the following operation, pay attention to the fact that the exhaust pipe has been heated due to the running of the engine.

Remove filter plate from sampling pump.

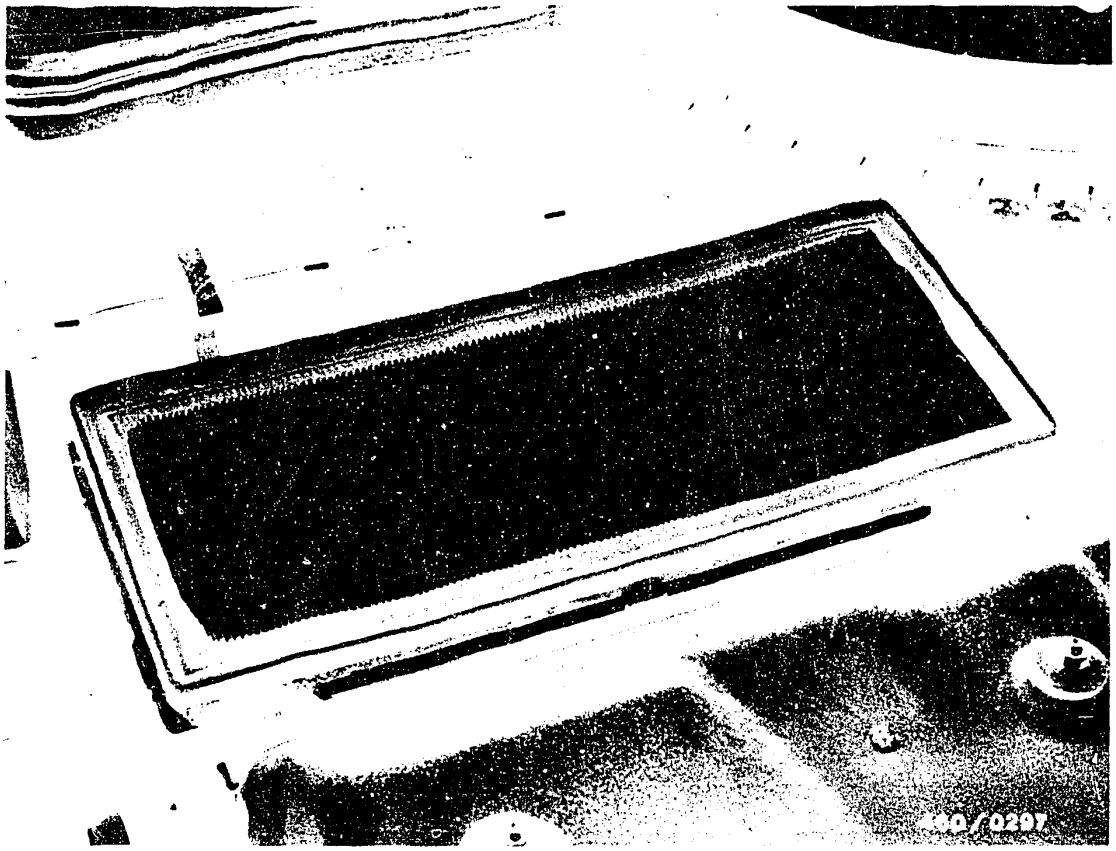



Place calibrating plate on approx. 10 clean filter plates. Place photocell of evaluating unit on calibrating plate. Switch on unit and set to 5.0 opacity. Remove calibrating plate and place photocell on clean filter plates. The unit must indicate 0.0 opacity. If necessary, change batteries.
With unit switched off, pointer must indicate 10.0 opacity. Deviations indicate that the unit is defective.
Place filter plate from sampling pump onto the clean filter plates with the sooted side at the top.
Place photocell on this filter plate and read off the smoke factor on the evaluating unit.




Compare smoke factor with evaluation sheet.

Note kW (HP-DIN) data of vehicle manufacturer.



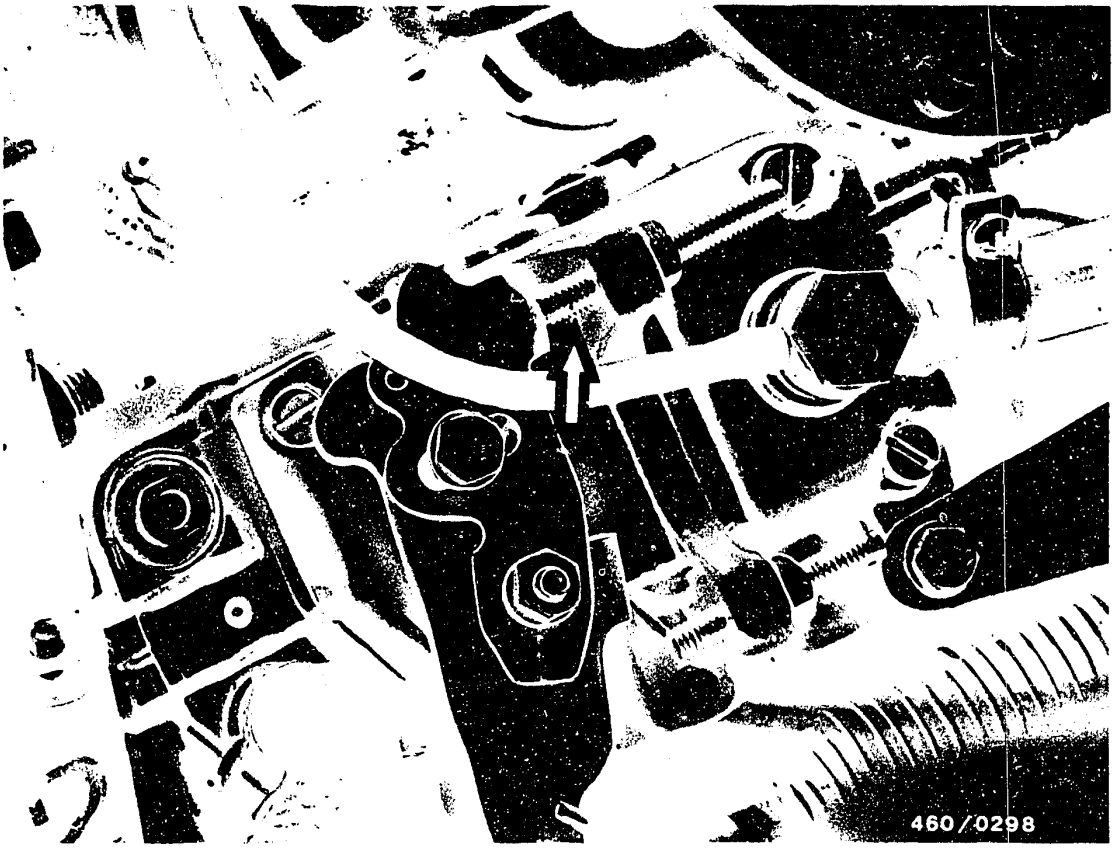
16.2 Check air filter

Remove air filter and subject to a visual inspection.

Test criteria for air filter:

- Dusty air filter
  (Test by knocking out air filter)
- Oil-fouled air filter
- Solid matter in air filter, e.g. leaves

If in doubt, use new filter element.




17. Adjust idle speed

Connect tachometer (e.g. photoelectric) to engine. Start engine and run at idle speed.

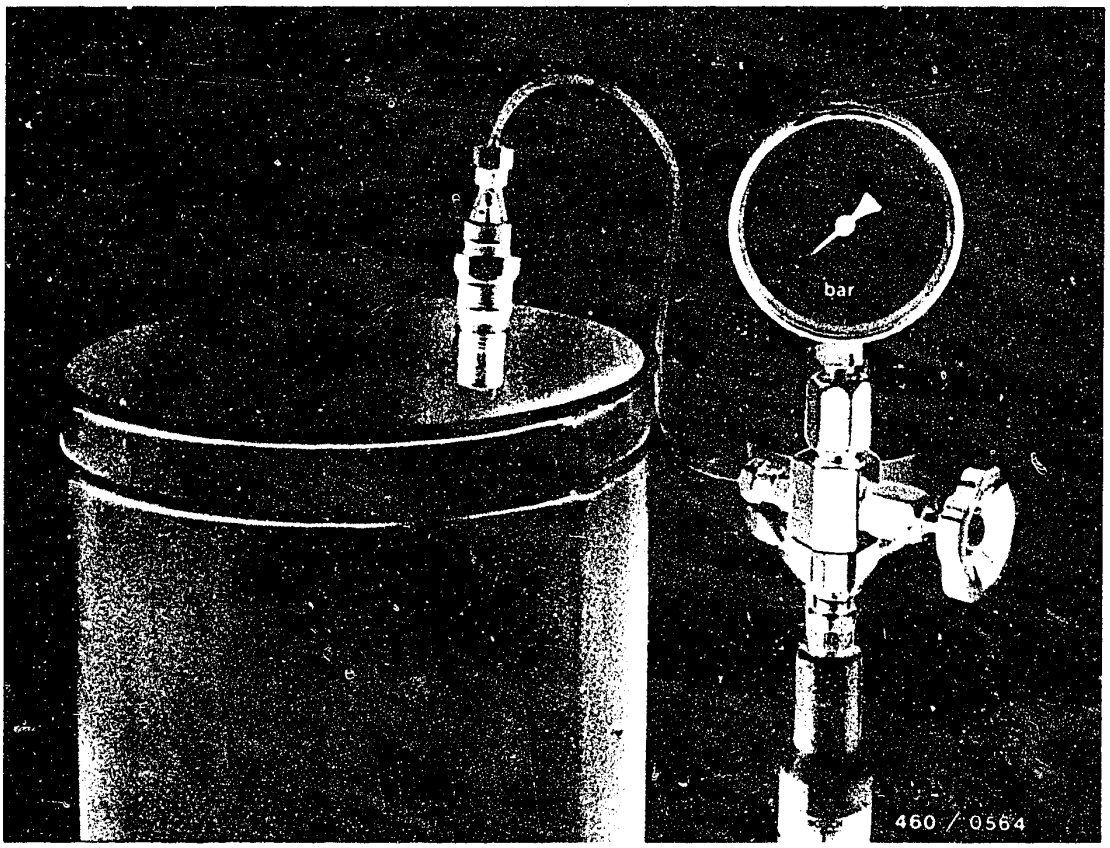
Note:

In order to adjust the idle speed the engine must be at normal operating temperature, coolant temperature 80°C.

Set engine speed at idle-speed-adjusting screw (arrow) to 750 ± 50 $min^{-1}$.

Note that the camshaft and the injection pump are driven at half the engine speed.

After adjusting, lock and seal the adjusting screw.



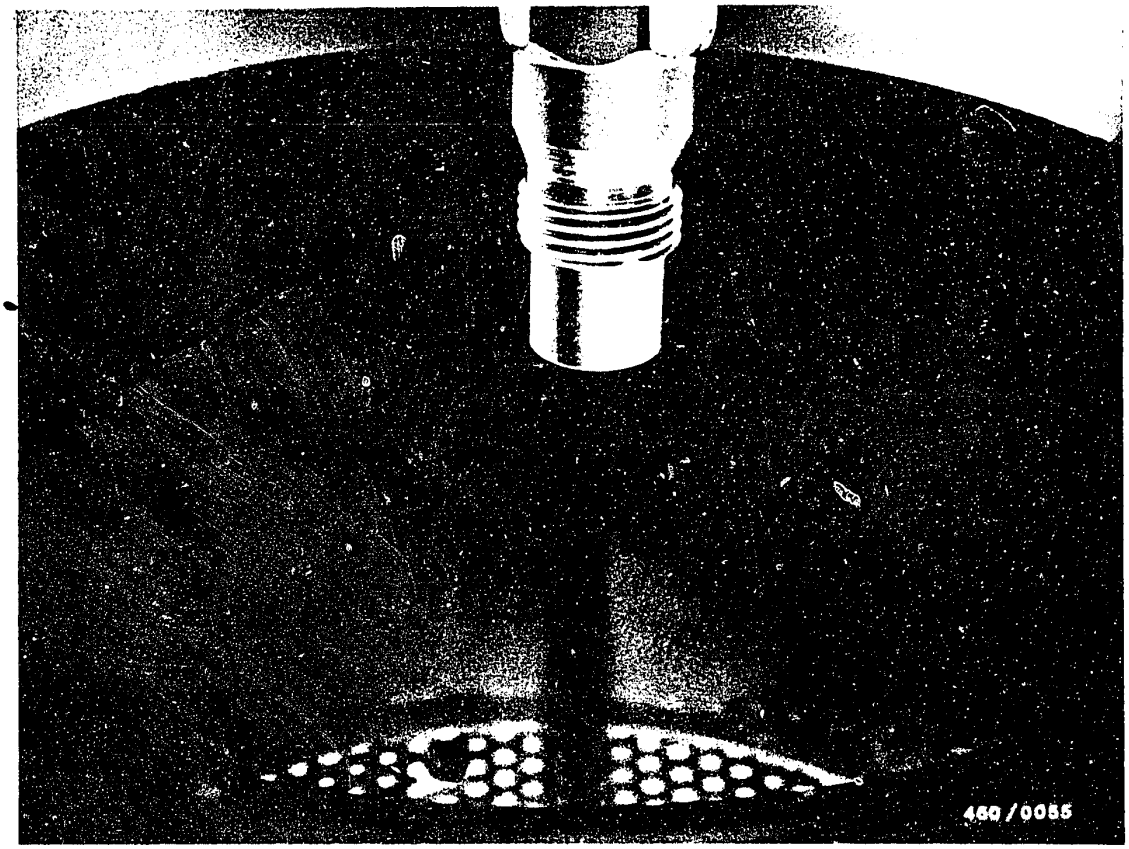

## 18 Test injection nozzles

Remove injection nozzles.

The test is performed using the nozzle tester EFEP 60 H 0 681 200 502.

Mount injection nozzle with nozzle-holder assembly on nozzle tester.

Caution:
When testing injection nozzles, make sure that the fuel spray does not strike your hands since, due to the high pressure, the fuel will penetrate into the skin and may cause blood poisoning.




18.1 Spray test

Switch off pressure gauge.

The spray pattern cannot be assessed until when the lever is being operated quickly (approx. 4-6 strokes per second). The spray must be quite concentrated and break off cleanly.

## 18.2 Chatter test

The pressure gauge is switched off.
Fully depress the lever of the tester slowly (1-2 strokes per second).
Nozzles in good working order must chatter when fuel escapes.

## 18.3 Check injection pressure

Switch on pressure gauge.
Slowly force lever downwards. When nozzle begins to squirt, read off injection pressure.
In the case of deviations from the nominal value, the nozzle-opening pressure must be adjusted by shims behind the pressure spring in the nozzle-holder assembly.

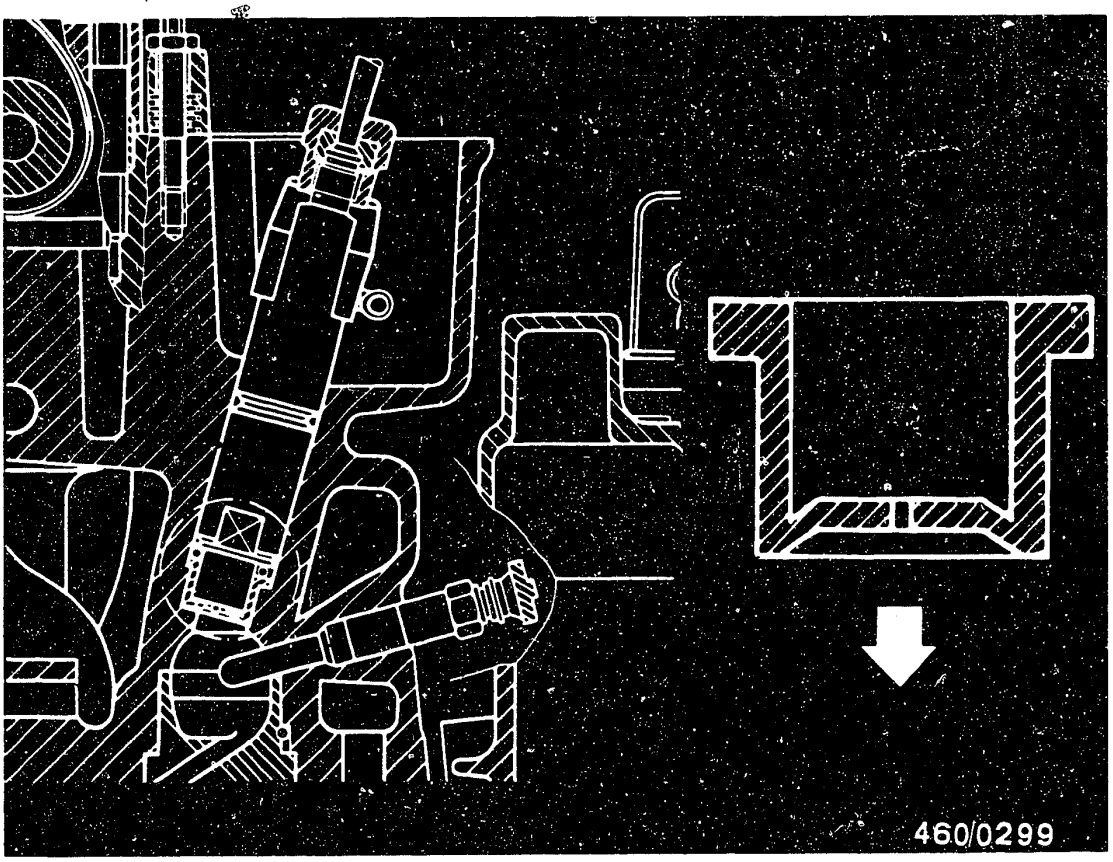
Nominal value: 135+8 bar

Thicker shims = higher nozzle-opening pressure
Thinner shims = lower nozzle-opening pressure

Increasing the spring travel by 0.05 mm causes a 5.0 bar increase in the nozzle-opening pressure.

## 18.4 Leak test

Pressure gauge on.
Slowly press lever downward and maintain pressure approx. 20 bar below the opening pressure for 10 seconds. No drop may fall from the nozzle.

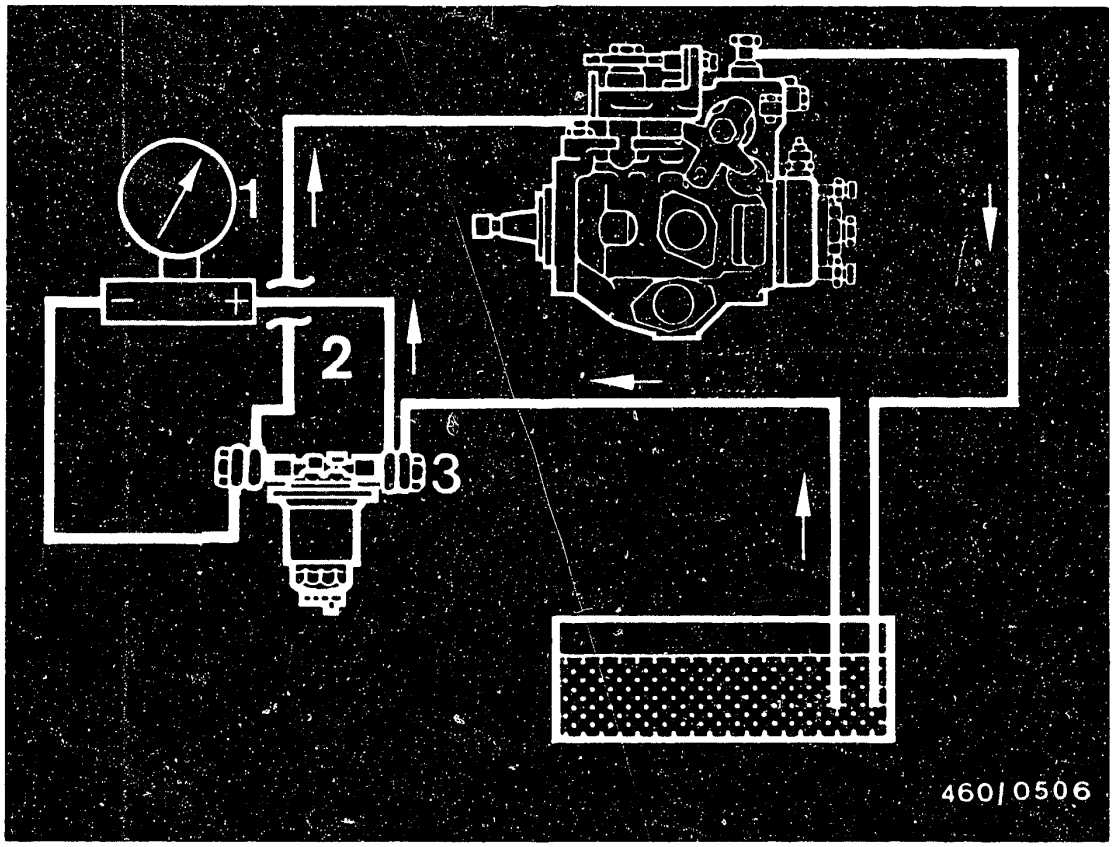



## 18.5 Install injection nozzles

Before installing the injection nozzles, fit a new heat seal in the direction of the arrow with respect to the cylinder head (Picture).

Tighten nozzle-holder assembly fastening screws to 39 Nm (3.9 kgfm) Ritmo 10.79 ... 10.82 or 49 Nm (4.9 kgfm) Ritmo as of 10.82.

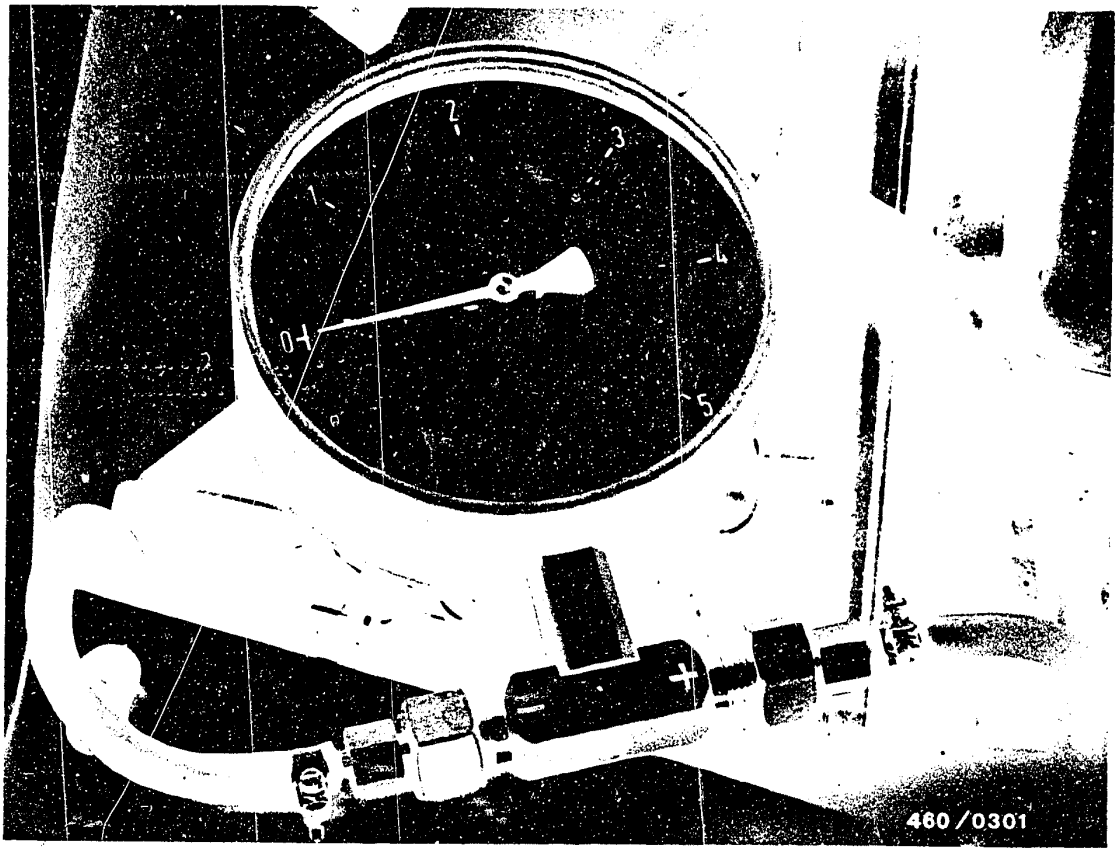
Tighten the union nuts of the fuel-injection tubing to 25 Nm (2.5 kgfm).




1 = Differential-pressure gauge
2 = Filter outlet (use inlet union and extra-long inlet-union screw 2 443 456 020).
3 = Filter inlet (use inlet union and extra-long inlet-union screw 2 443 456 020).

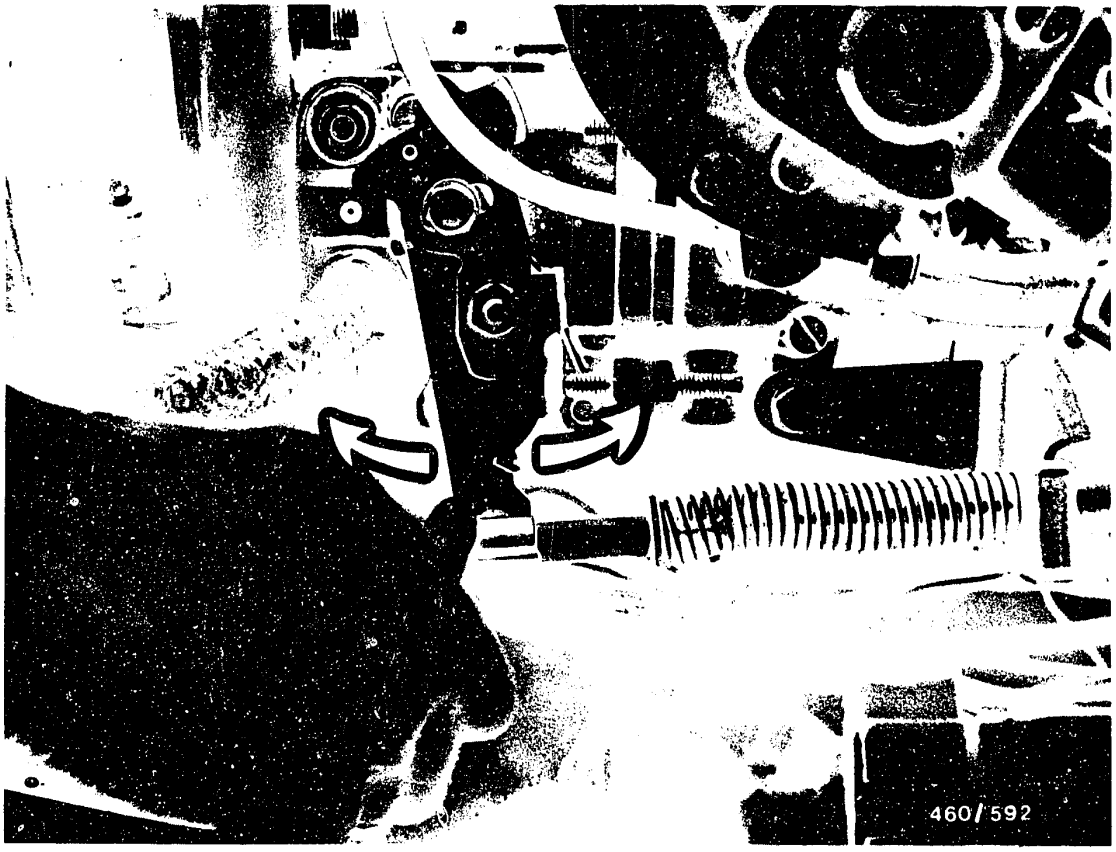
## 19. Connection diagram for filter test

Connect differential-pressure gauge to fuel filter using appropriate connecting pieces.




Connect the (+) side of the differential-pressure gauge to the fuel filter inlet. Fit the (-) connection of the pressure gauge to the filter outlet. See connection diagram.

Run engine until you are sure that there is no air in the fuel system.




Move injection-pump control lever briskly (approx 1 second) from the idle stop to the maximum-speed stop.

Release control lever and read off differential pressure on pressure gauge.

The differential pressure may be max. 0.3 bar.
If this value is exceeded, replace filter. Remove test connections.

If necessary, bleed fuel system.

## 20. Check pre-heating system

### 20.1 Necessary test equipment

Voltmeter/ammeter e.g. ETT 011.00 0 684 101 100

### 20.2 Workshop information

20.2.1 We recommend that the "R"-type sheathed-element glow plugs be replaced every 45 000 km.

#### 20.2.2 Pre-heating times

The pre-heating time is dependent on the ambient temperature.

## Test preheating system

The preheating system is in operation during starting. If, after the indicator lamp goes out, the starting motor is not actuated, the preheating system switches off automatically after approx. 10 - 15 seconds.

If, on the other hand, the engine is started, the power supply to the glow plugs is maintained in the post-heating time (likewise for approx. 10 - 15 seconds) in order to prevent excessive smoking in the initial phase of operation.

Note:

If a glow plug or the power-supply lead has a short circuit to ground, the power supply to the glow plugs will be cut by the glow-duration unit.

Caution!

Never connect test lamp in parallel between terminal 6 of glow-duration unit and a ground point since this will lead to the destruction of the glow-duration unit.

Test preheating system

All engines are equipped with a rapid preheating system.

- Test condition: Battery o.k.?

Test power supply

- Connect test lamp in parallel between glow plugs and ground
- Turn glow-plug and starter switch to "drive" position.
- Test lamp and glow-plug indicator lit?

No

Check ground terminal on glow-duration unit

- Connect voltmeter (e.g. VA tester ETT 011.00) between terminals 1 and 2 on glow-duration unit.
- Battery voltage present?

No

Test ground terminal (lead, black) on glow-duration unit.

Yes

Yes

Check power supply to glow-duration unit

- Connect voltmeter between terminals 2 and 3 on glow-duration unit.
- Turn glow-plug and starter switch to "drive" position.

Battery voltage present?

No

Test connecting lead (orange) from glow-plug and starter switch to glow-duration unit and corresponding contacts for open circuit.

Yes

Continued on C17/C18

Continued on C17/C18

Yes

Test preheating time and on-time.

Turn back glow-plug and starter switch and return to drive position.
Measure preheating time.
When glow-plug indicator lamp goes out test lamp must remain lit for a further approx. 10 - 15 seconds.
Preheating time should conform to the following table.

| Engine compartment temperature | Preheating time |
|---|---|
| at - 20°C | approx 21 ... 27 sec |
| at + 20°C | approx 4.5 ... 7 sec |
| at + 50°C | approx 1.5 ...4.5 sec |

No → Repeat test with new glow-duration unit

Yes

Continued on C19/C20

Yes

Check power supply to glow-duration unit when starting.

- Connect voltmeter between terminals 2 and 4 on glow-duration unit.
- Turn glow-plug and starter switch to position "start".

Battery voltage present?

No → Test connecting lead (red-black) from glow-plug and starter switch to glow-duration unit for open circuit.

Yes

Check power supply to glow-plug indicator lamp

- Connect voltmeter between terminals 6 and 2 on glow-duration unit.
- Turn glow-plug and starter switch to position "drive".

Battery voltage present?

No → Test connecting lead (orange) from glow-plug and starter switch to glow-duration unit and corresponding contacts for open circuit.

Battery voltage present?

No → Glow-duration unit defective, replace.

Yes

Yes

Check glow-plugs

If there is difficulty starting, check whether all glow-plugs are working properly.

Test voltage at glow-plugs with test lamp:

- Remove lead and bus bar for glow-plugs.
- Connect test lamp to battery + and, one after the other, to each glow-plug.
- Lamp lit = glow-plug o.k.?
- Lamp not lit, glow-plug defective, replace (tightening torque 15 Nm). If glow-plugs burned out, see Note on right.

Test power supply to glow-plugs with VA tester ETT 011.00:

- Connect ammeter (e.g. ETT 011.00) into lead to glow-plugs.
- Turn ignition key to "preheating".
- Make reading of current.

  Set value: approx. 40 A

Set value reached?

No →

Note:

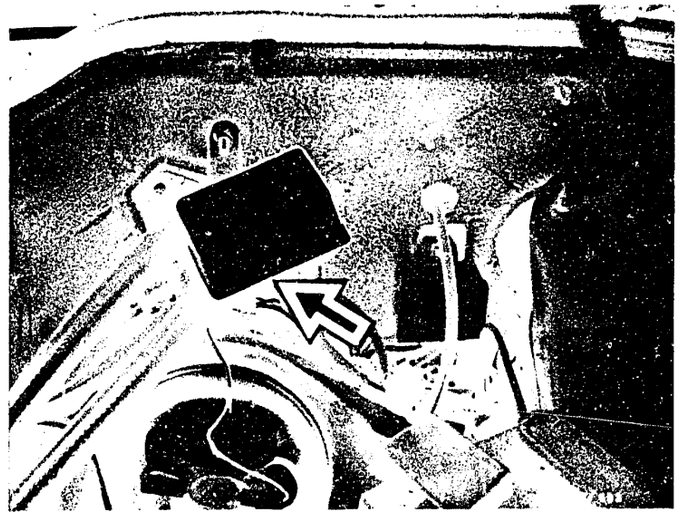
Current consumption after stabilisation approx. 10 A per glow-plug. If current consumption of glow-plug is approx.

30 A = one glow-plug defective
20 A = two glow-plugs defective
10 A = three glow-plugs defective

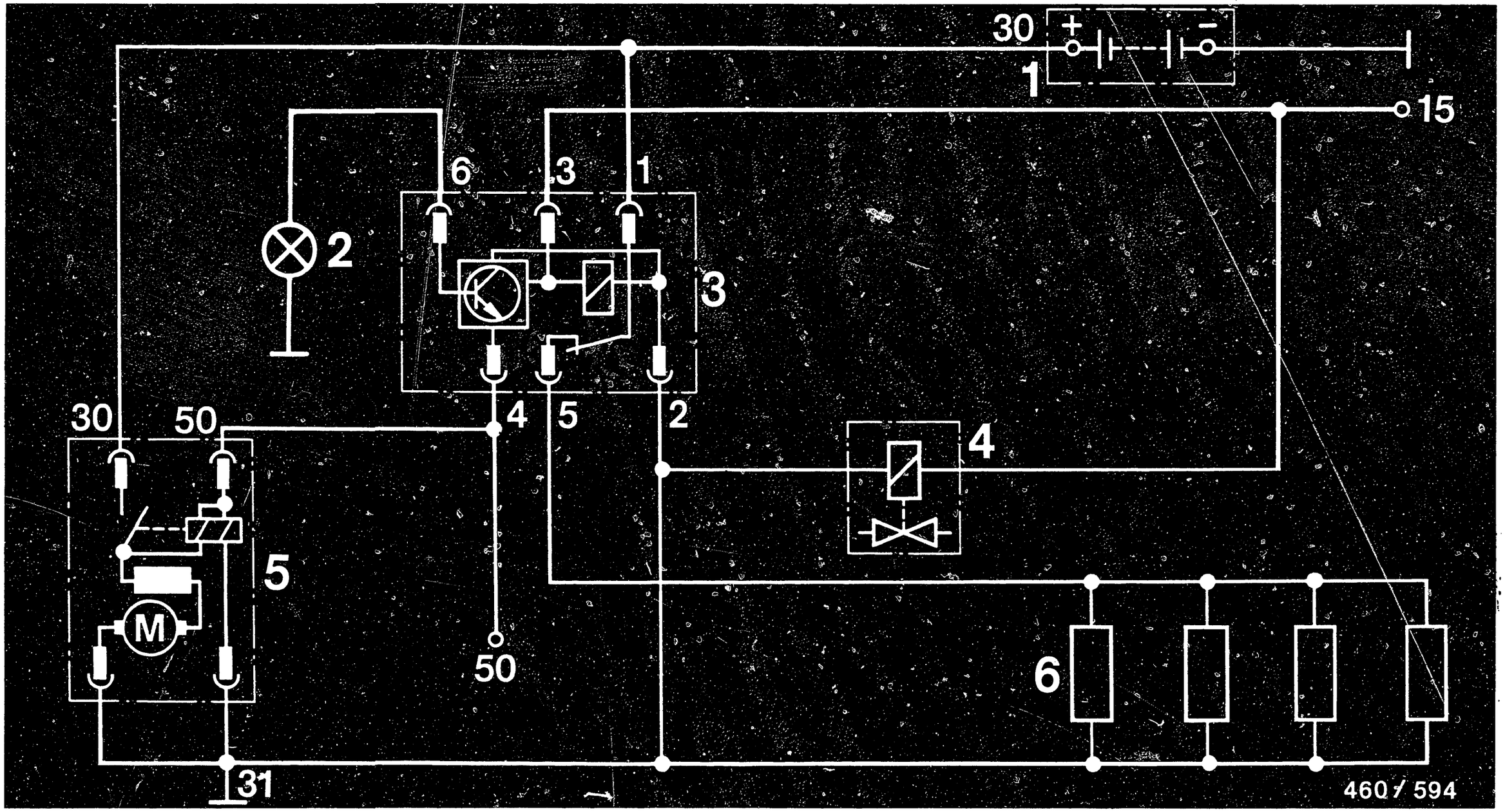
These current readings are only obtained with a battery voltage of above 120 V.

Yes

Glow-plugs o.k. (Fault is in fuel supply).

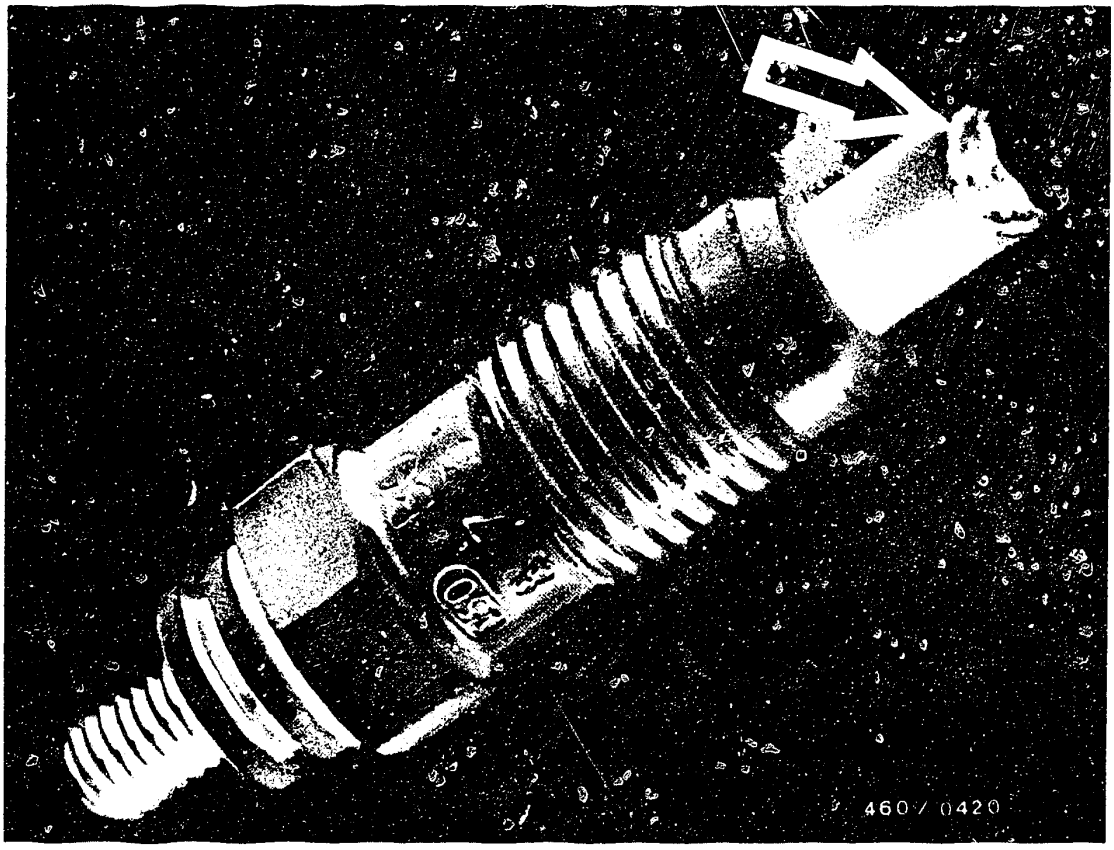


Installation position of glow-duration unit (arrow)




1 = Battery
2 = Preheating indicator lamp
3 = Glow-duration unit
4 = Solenoid-operated valve
5 = Starting motor
6 = Glow plugs

20.3 Terminal diagram for preheating system




Note:

Glow plugs with burned elements

Glow plugs with burned elements are frequently the result of troubles with the injection nozzle.

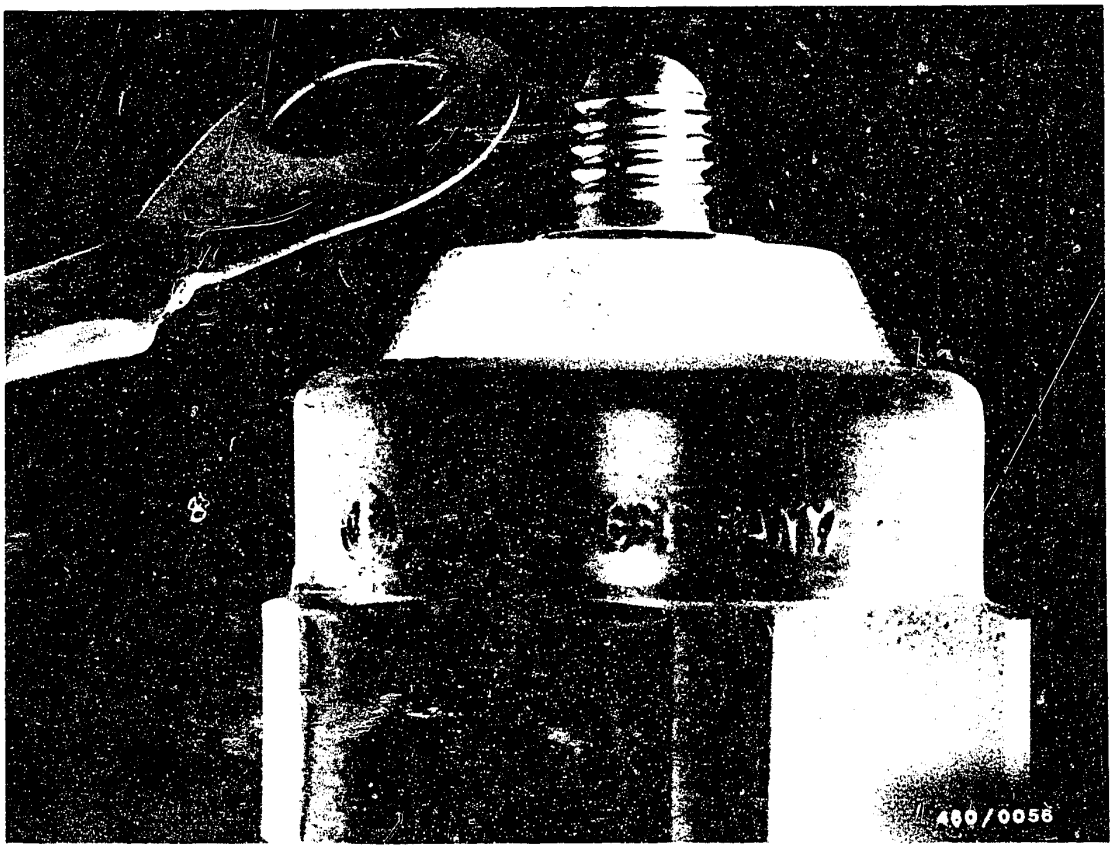
If glow plugs are found to have burned elements (arrow), it is not sufficient simply to replace them. The injection nozzles must also be tested for spray pattern, chattering, pressure and leaks.

## 21. Check timing device

In distributor-type fuel-injection pumps VE..F.. the timing device is integral with the fuel-injection pump.

In order to test the timing device, it is necessary to remove the fuel-injection pump.

Perform the test on the injection-pump test bench.




## 22. Measure engine compression and compression loss

### 22.1. Measure engine compression

Fit new chart in compression tracer. Mount high-pressure hose on tracer. Switch off engine.
In order to prevent fuel from being injected, remove connecting cable from shutoff magnet on distributor-type fuel-injection pump (picture).

Unscrew nozzle-holder assembly and use suitable connection nipple for compression tester.

Using the starting motor, turn over the engine several times so that loose deposits are removed from the combustion space.

Screw in connection nipple.
(Make sure there are no leaks when screwing into the bore of the nozzle-holder assembly).

Fit high-pressure hose of compression tester onto connection nipple.

During the following operation, note first compression stroke.

Operate starting motor until there is no longer any detectable rise in pressure on the compression tracer.

Bleed compression tracer by pressing on bleeder valve.

The pointer returns to the starting position.

Move chart onto next position.

Fit connection nipple to the other cylinders and repeat measurement.

## 22.1.1 Evaluation of chart

### 1. Normal pressure rise

If piston rings and valves are in good condition, the first compression stroke shows the highest pressure increase.
During the following compression strokes the compression builds up to the maximum pressure.

### 2. Gradual pressure rise

If, from the start, the compression increases only gradually on each piston stroke, this points to burnt valve seats or defective valve guides.

### 3. Low maximum pressure

If the maximum pressure obtained is too low on all cylinders, this points to defective pistons, piston rings or valves.
If the compression is too low on two neighbouring cylinders, this points to a leaky cylinder head gasket.

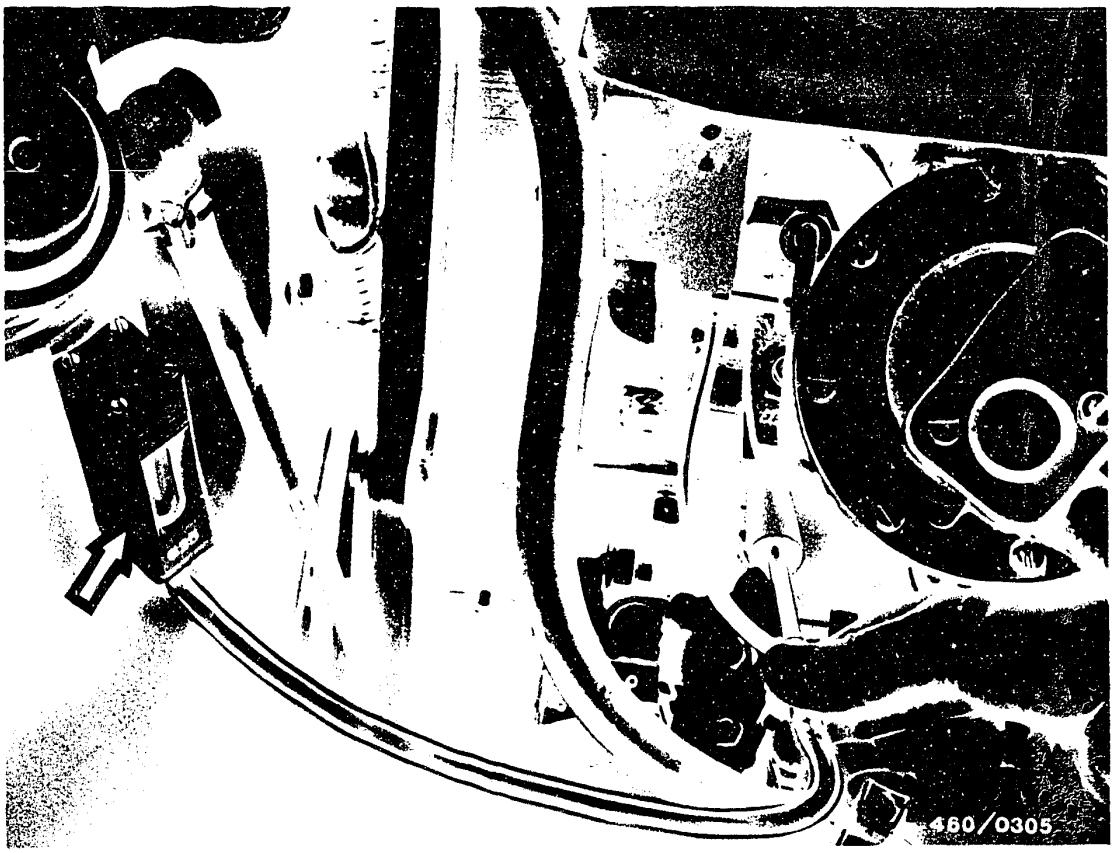
## 4. Varying compression

If one cylinder shows a clearly lower compression, proceed as follows: fill in 2-3 $cm^3$ of engine oil through the opening of the sheathed-element glow plug or nozzle-holder assembly and operate starting motor briefly.

Repeat measurements and compare charts. If there is a clear increase in compression during the second test, then the piston rings or cylinders are worn.
If there is no change in the result, then defective valves are the cause.

## 5. Uniform compression

Uniform compression is extremely important with regard to the smooth running of the engine. Maximum compression is, therefore, not the only objective.



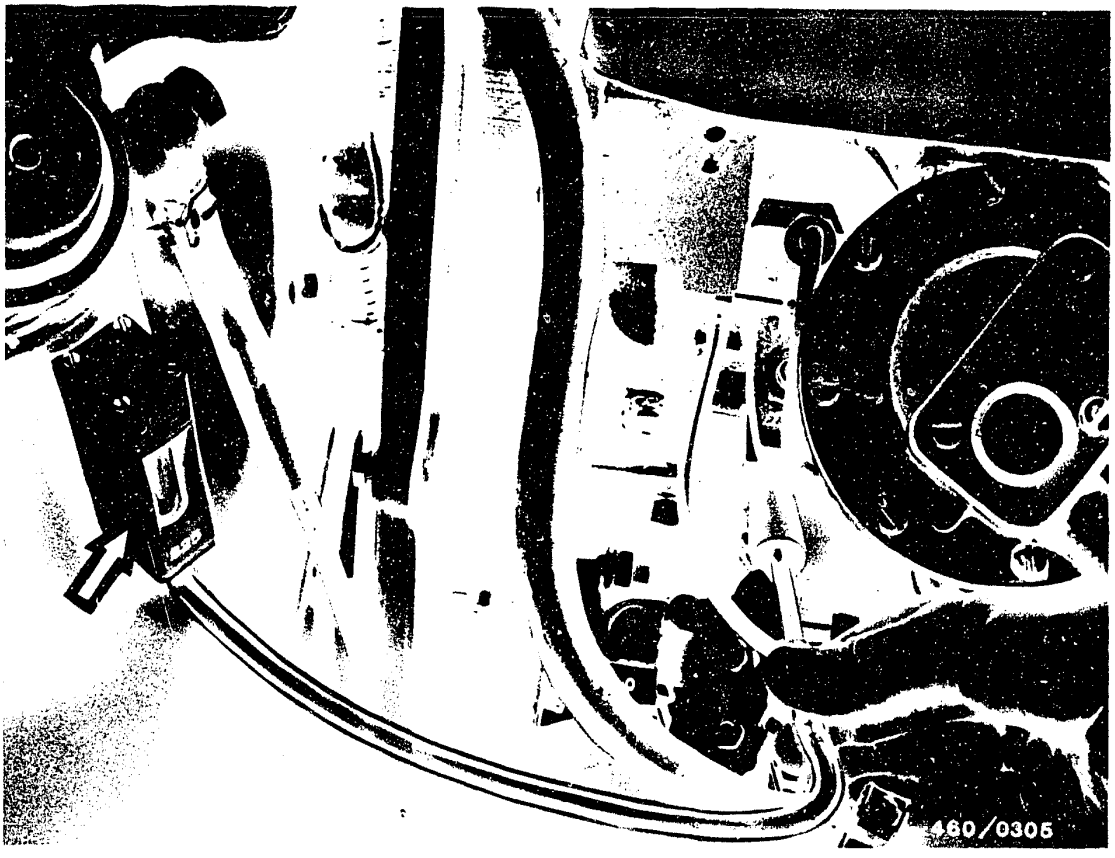

## 22.2 Measure compression loss of engine

The test is performed using the Bosch compression-loss tester 0 681 001 901 (EFAW 210 A).

For testing, the respective piston must be at TDC (TDC = top dead centre) on the compression stroke.

For setting this point, use DC detector 1 688 132 025 (included in accessories with compression-loss tester).

Perform test with engine at normal operating temperature (temperature of water approx. 80°C).



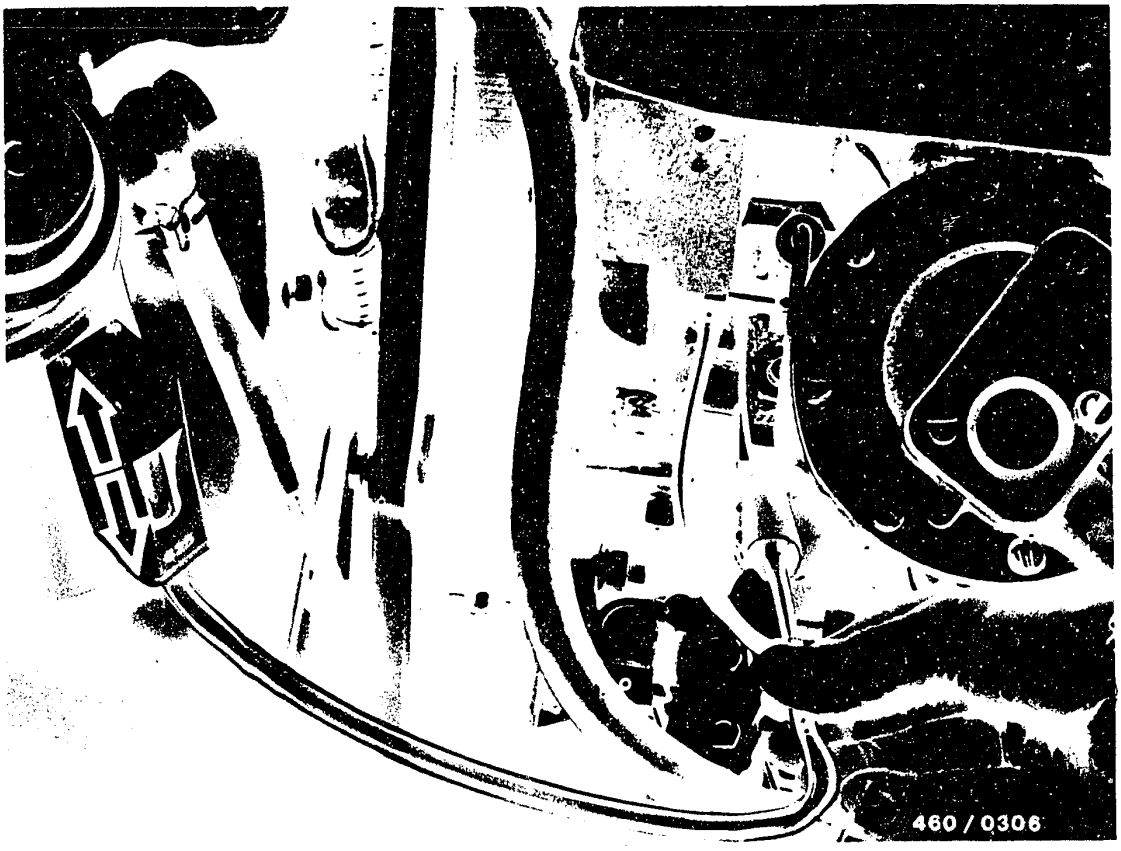

## 22.2.1 Set top dead centre

Remove sheathed-element glow plug from cylinder 1.

Insert rubber plug of DC detector into bore for sheathed-element glow plug.

Using magnetic clamp, mount glass cylinder in as vertical a position as possible in the engine compartment.
The piston of the unit must be easily visible.

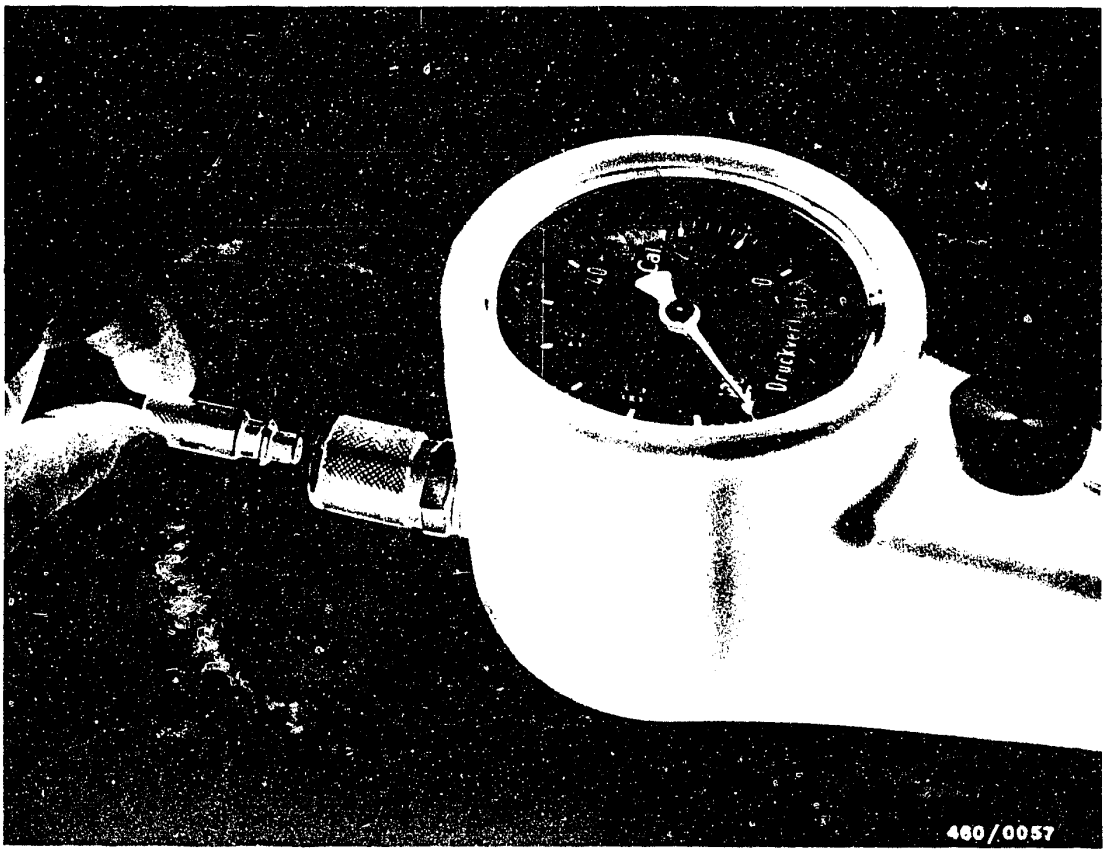
Slowly turn the engine over by hand in its direction of rotation.
(If necessary, select gear and push vehicle).




On the compression stroke, the piston of the DC detector is forced upward.

As top dead centre is passed over, the piston slides down again immediately.

Locate top dead centre by carefully turning the engine backwards and forwards.




## 22.2.2 Measure compression loss

Connect tester to compressed-air mains.

Connect calibrating nozzle 1 680 363 036. Set a compression loss of 23 ± 1% (marking "Cal".) at the knurled thumbscrew on the pressure-regulating valve. Disconnect calibrating nozzle.

(Instrument indicator must show approximately 0% compression loss - equipment check.)


Screw in fitting and mount test hose.
Select gear and pull on handbrake.
Connect test hose to tester.
Read off compression loss in % on instrument.

Note:
Before testing the next cylinder, turn the engine over briefly without pre-heating using the starting motor so that the oil film re-forms.

## 22.2.3 Evaluation of test

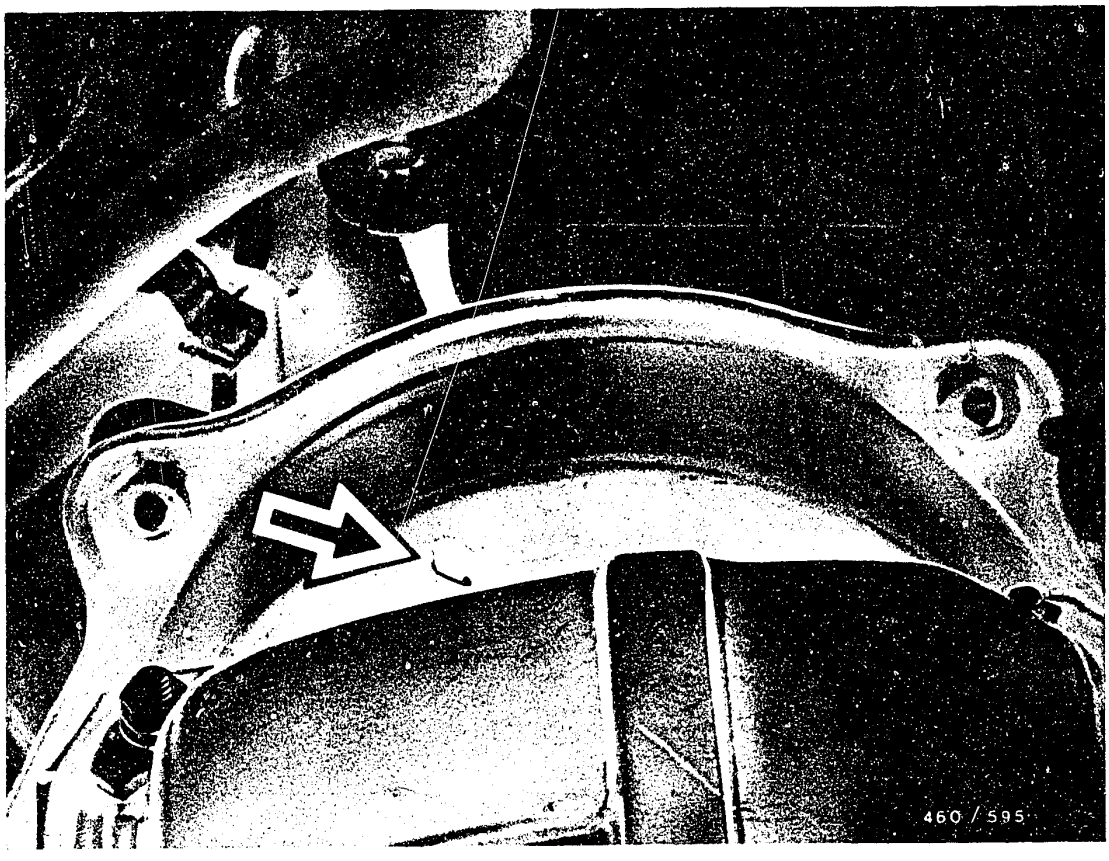
The compression loss indicated should not exceed 25%.

Differences of 10% between the individual cylinders can be ignored.
The causes of greater losses can be located because the air makes a noise as it escapes.
Listen at the following points:

| Location of noise | Possible trouble |
|---|---|
| Intake manifold (remove air filter) | Intake valve |
| Exhaust manifold | Exhaust valve |
| Oil filler neck on engine | Pistons, piston rings |
| Cooling water filler neck (air bubbles) | Cylinder head gasket |

In order to trace the trouble even more accurately, fill approximately 2-3 $cm^3$ of engine oil into the cylinder. Repeat test.
If there is a clear decrease in compression loss during this test, then the fault lies with the piston or with the piston rings.

New engines which have not yet been run in (less than 5,000 km) may show higher compression losses than after the running-in period.

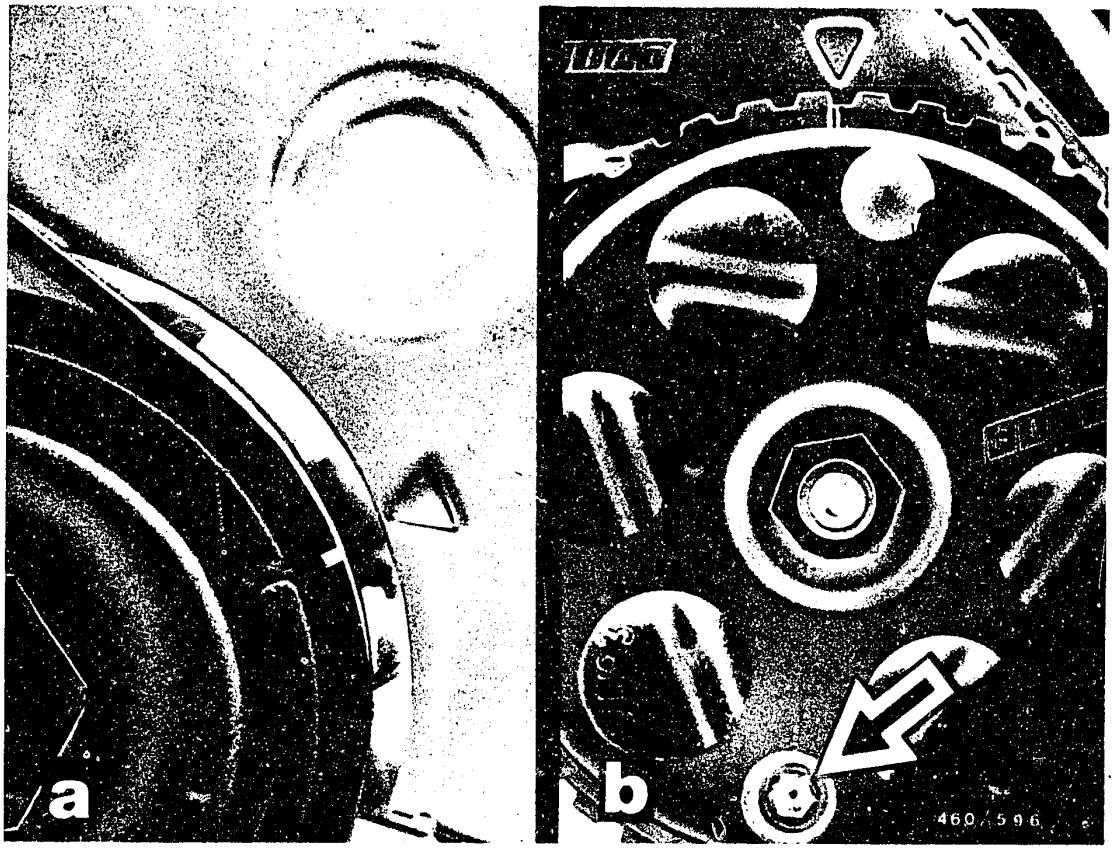



## 23. Remove fuel-injection pump

Disconnect the negative cable from the battery.

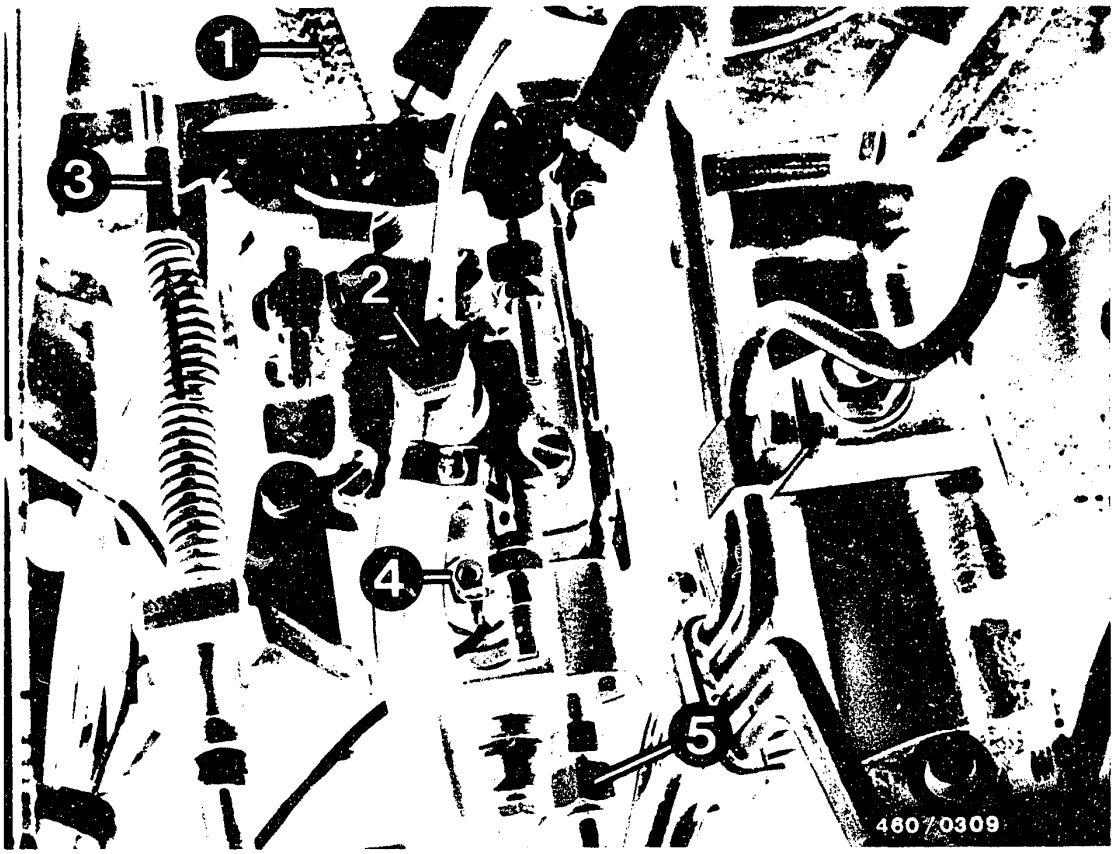
Remove cover for engine timing and injection-pump drive.

Turn crankshaft so that marks on camshaft gear and cover plate are in alignment (arrow).




With the engine in this position, the marks on pulley (on engine crankshaft) and cover plate must be in alignment (Fig. a).

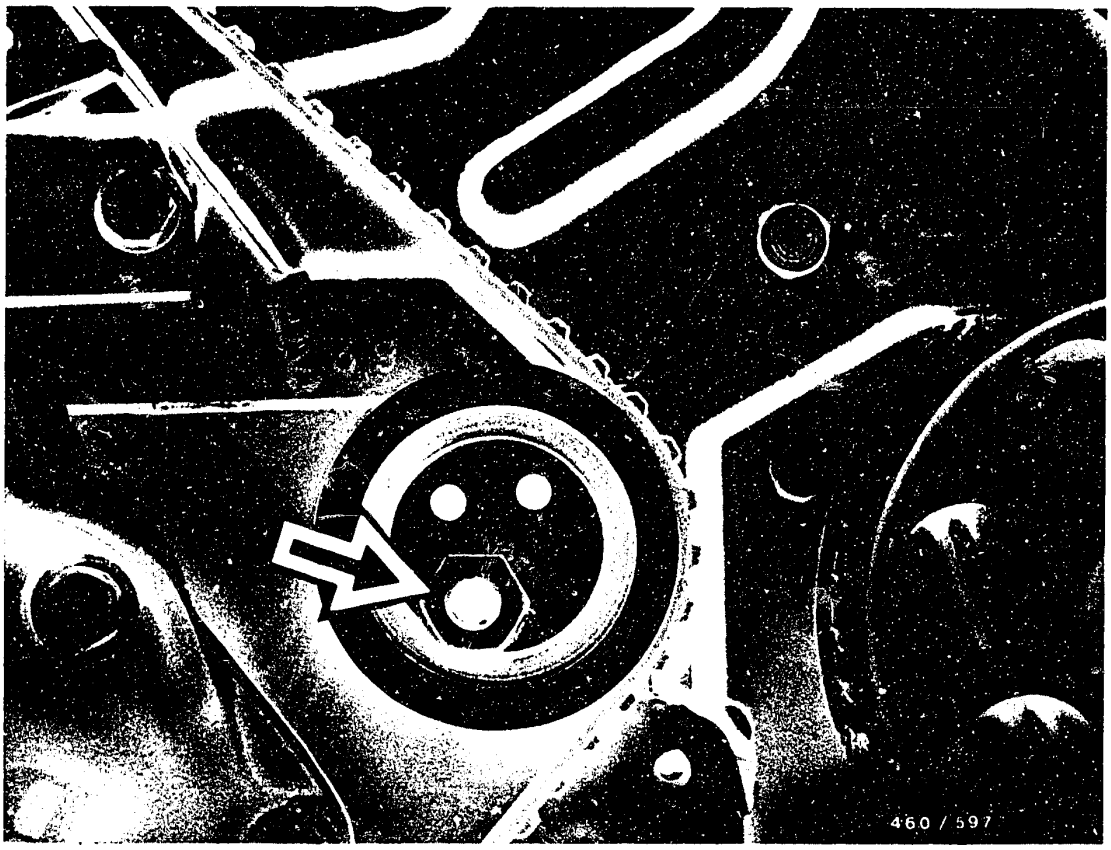
The mark on the pump drive gear points to the mark in the cover plate (Fig. b).




Remove fuel inlet line (1), fuel return line (2), cable (3) on control lever, electric lead (4) on shutoff solenoid and fuel-injection tubing (5) from injection pump.

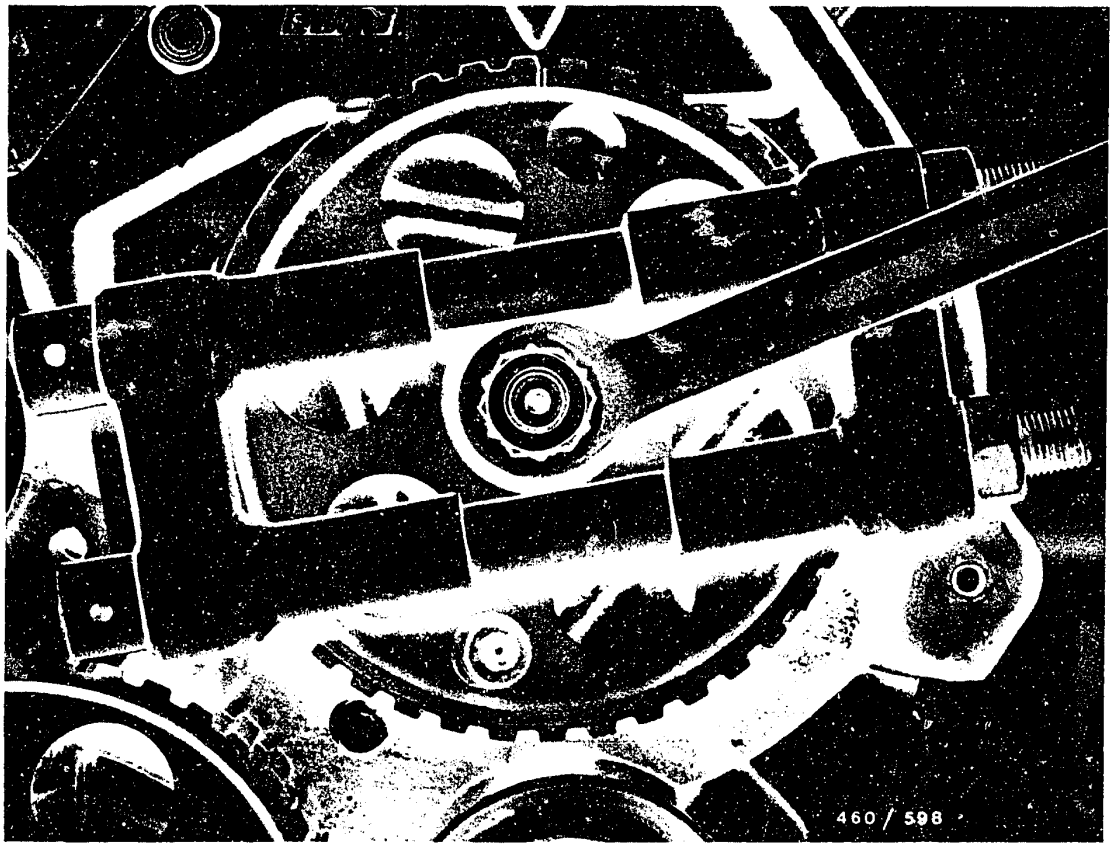
Note:

Prevent the delivery-valve holders from coming loose by holding with a wrench.



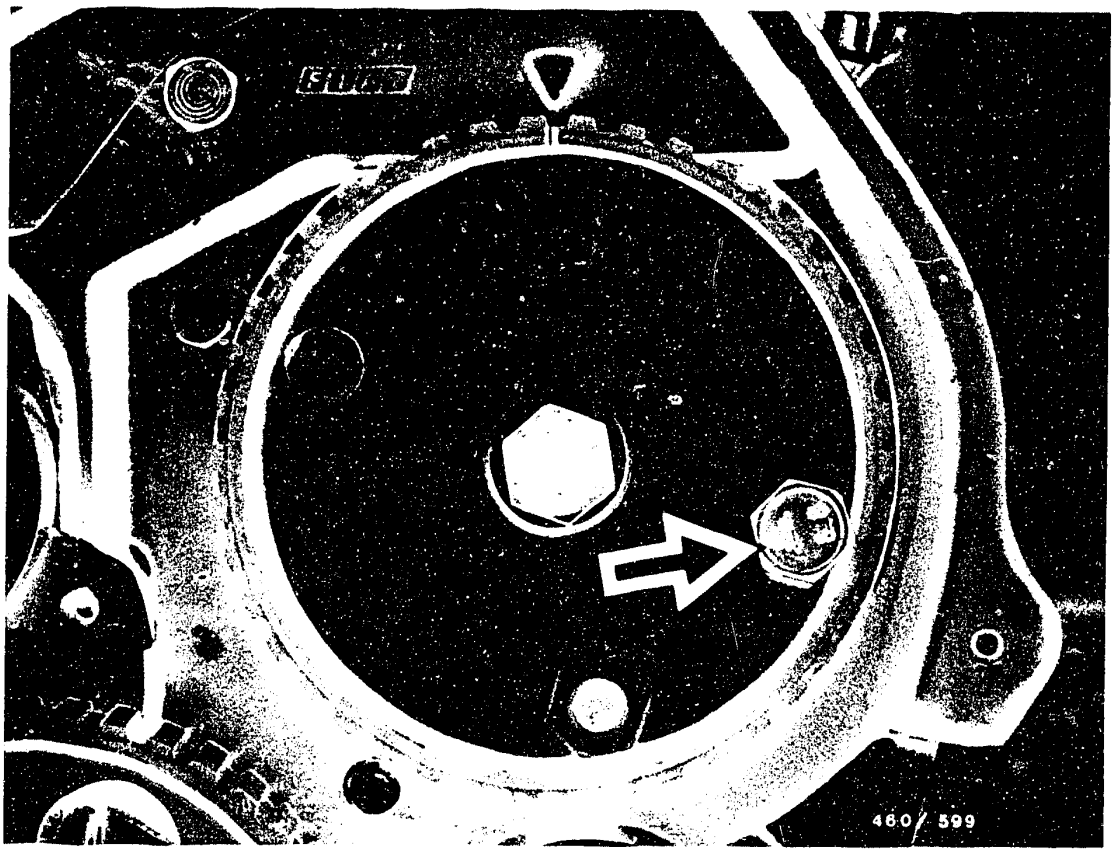

Loosen belt tensioning roller fastening screw (arrow).

Remove toothed belt from camshaft gear and injection-pump gear.




Mount holding device A 60473 with part-piece A 60473/10 on injection-pump drive gear.

Loosen injection-pump gear fastening nut and screw out by approx. 2 turns.

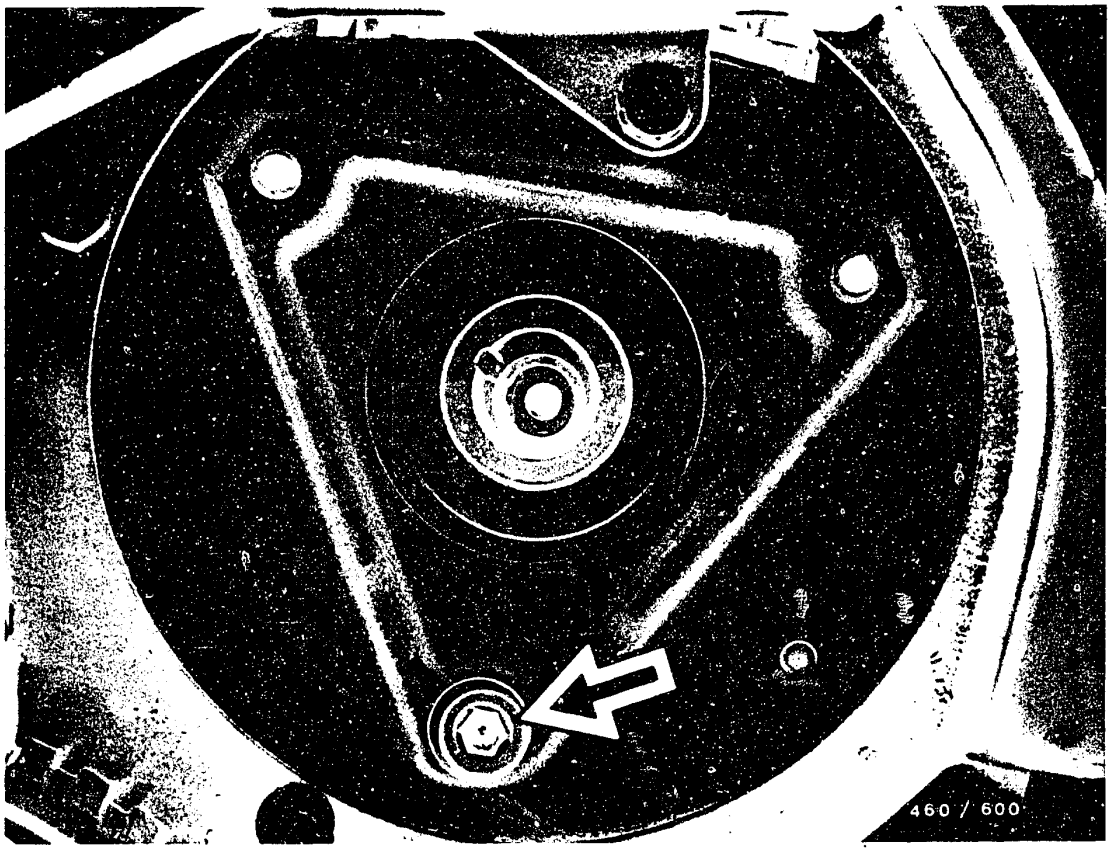



Remove holding device from injection-pump gear.

Mount puller A.42128 on injection-pump gear and fix with adjusting screw (arrow).

Remove injection-pump gear.

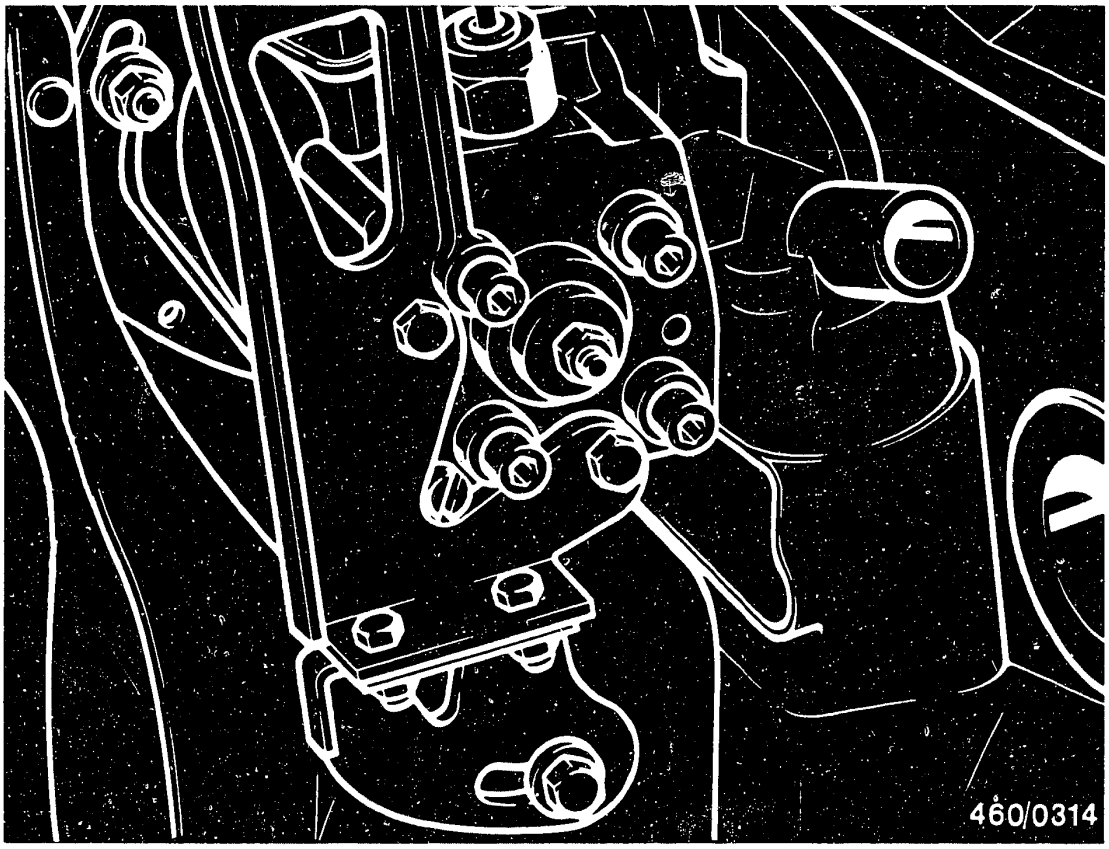
Remove puller, fastening nut with retainer and injection-pump gear.




From the drive side, remove lower fastening screw on pump flange (arrow).

Remove upper fastening nuts on pump flange and fastening screws on hydraulic head support bracket.

Remove injection pump from engine.
Pay attention to holding bracket in front of pump flange.

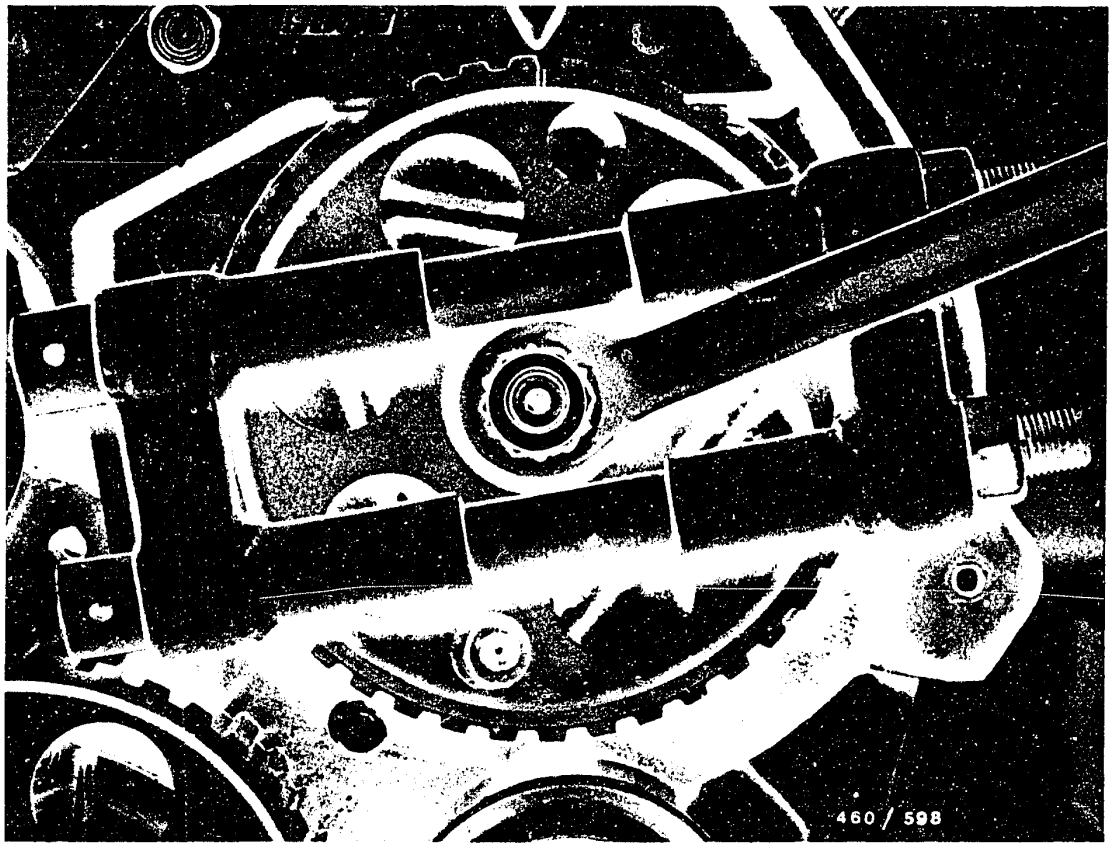



## 24. Install fuel-injection pump

Position injection pump on engine and attach holding bracket for lower fastening screw on pump flange.

Pivot injection pump into centre position of slots.

Screw on fastening nuts and finger-tighten.

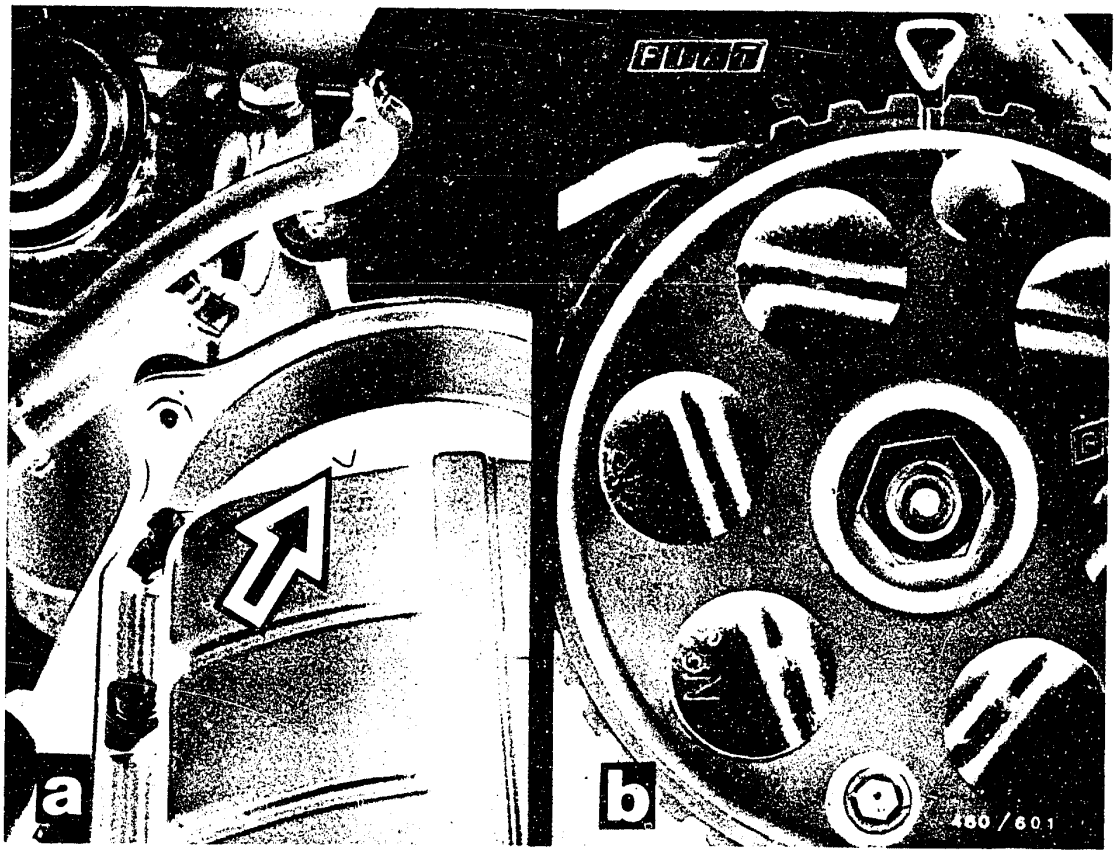



Mount injection-pump gear (Woodruff key in cone of pump drive shaft must be installed) and turn so that marks on injection-pump gear and cover plate are in alignment.

Screw on injection-pump gear fastening nut with retainer.

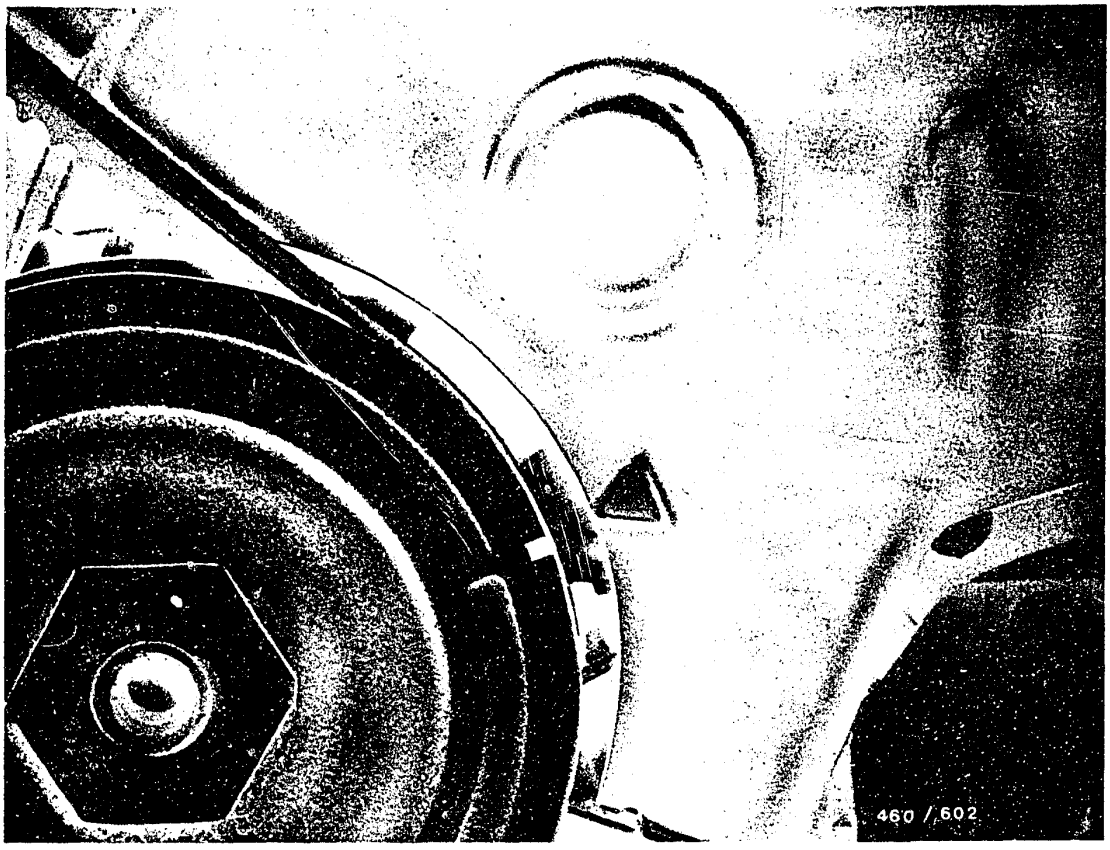
Mount holding device A 60473 with part-piece A.60473/10.

Tighten injection-pump gear hexagon nut to 49 Nm (4.9 kgfm).




Position toothed belt on injection-pump gear and camshaft gear.

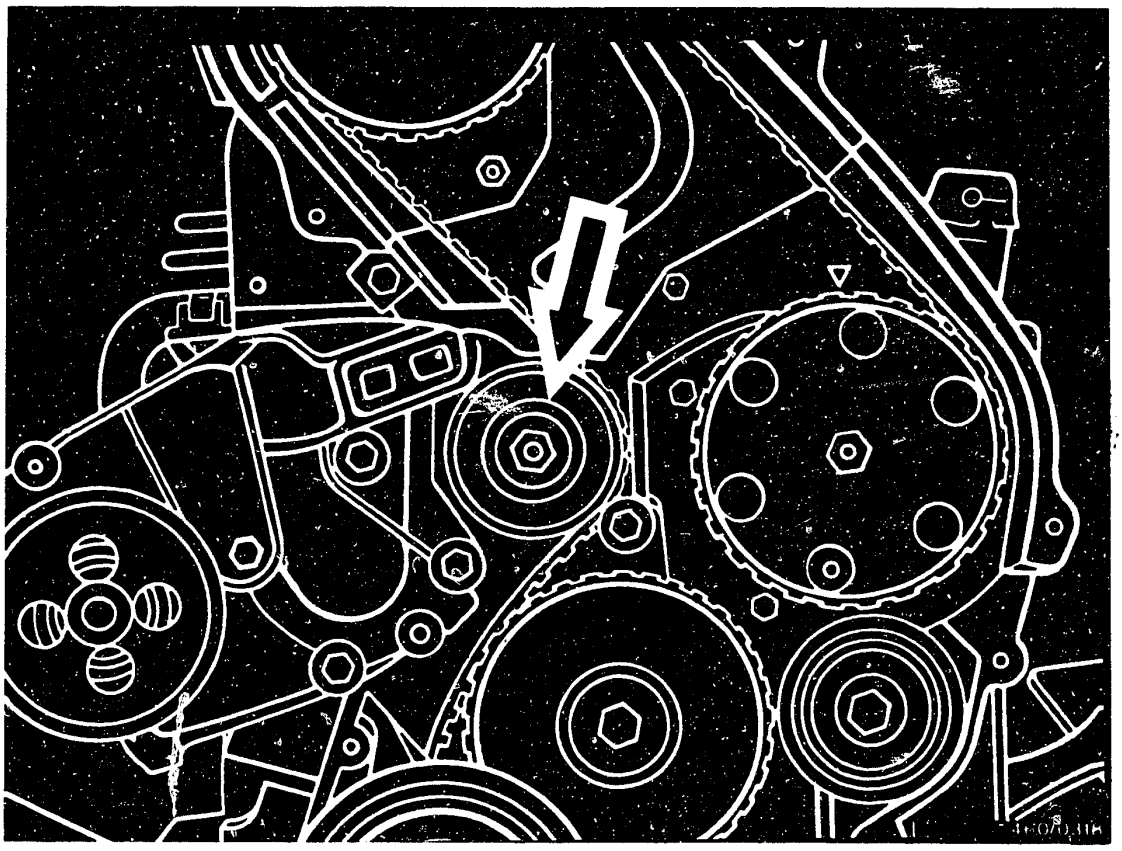
The marks on camshaft gear (Fig. a, arrow) and injection-pump gear (Fig. b) point to the reference marks on the cover plate.




The mark on the crankshaft gear pulley points to the reference mark on the cover plate.

To check the position of the toothed belt, remove lower engine timing cover plate and check whether toothed belt is resting correctly on crankshaft gear.

Remount cover plate.

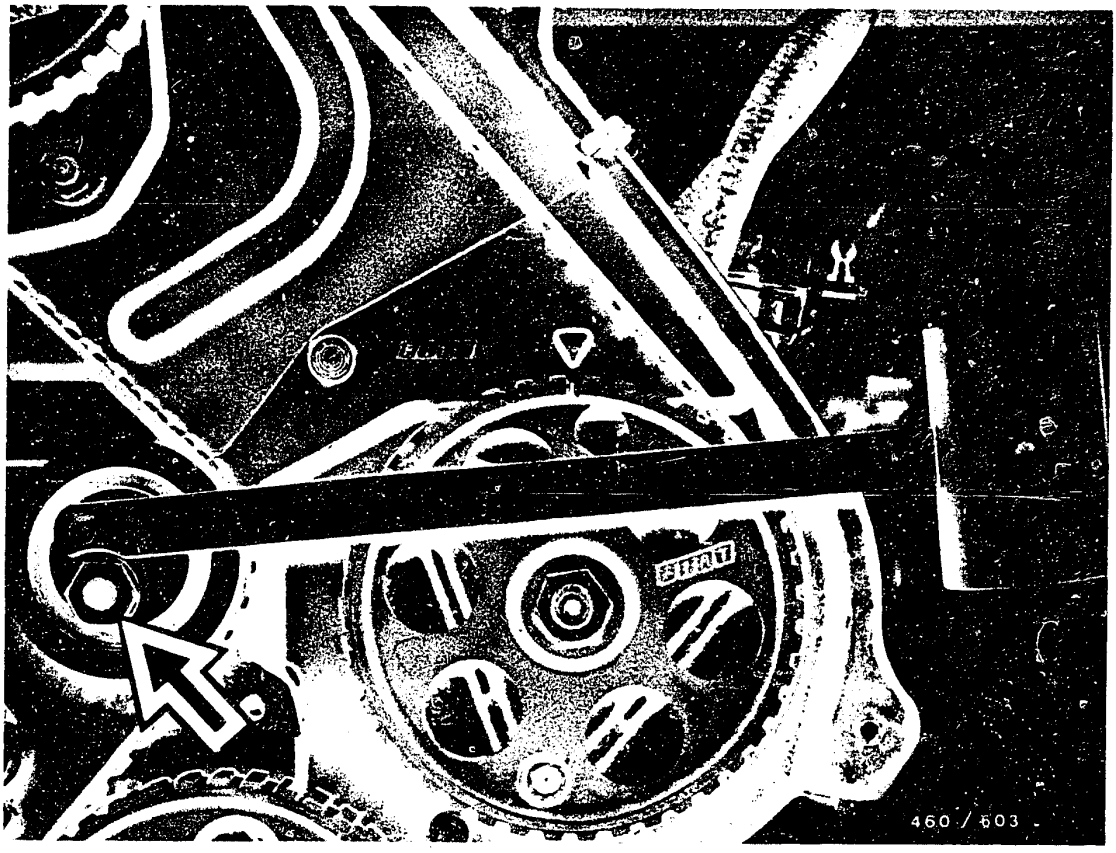


Only Ritmo - date of manufacture 10.79 - 10.82

Loosen belt tensioning roller holder fastening screw (arrow) until spring-loaded belt tensioner presses against toothed belt.

Re-tighten fastening screw.
Turn crankshaft over two complete times in engine direction of rotation until the marks on camshaft gear, injection-pump gear and crankshaft gear are in alignment with those on the cover plate.

Loosen belt tensioning roller holder fastening screw until spring-loaded belt tensioner presses against toothed belt.
Tighten fastening screw to 44 Nm (4.4 kgfm).

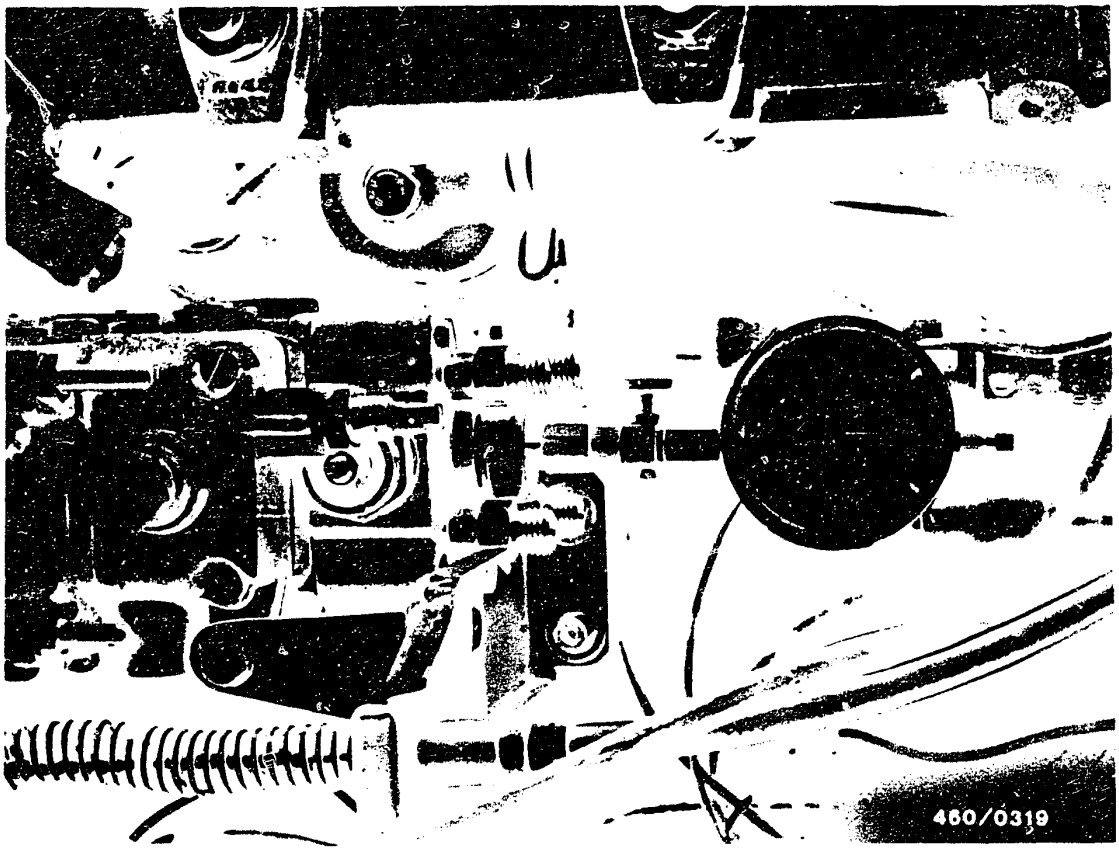



Only Ritmo as of 10.82 date of manufacture

Loosen belt tensioning roller fastening nut (arrow). Turn belt tensioning bearing in clockwise direction and position tool A.60722 for tensioning toothed belt.

Turn crankshaft over twice in engine direction of rotation until the marks on camshaft gear, injection-pump gear and crankshaft gear are in alignment with those on the cover plate.

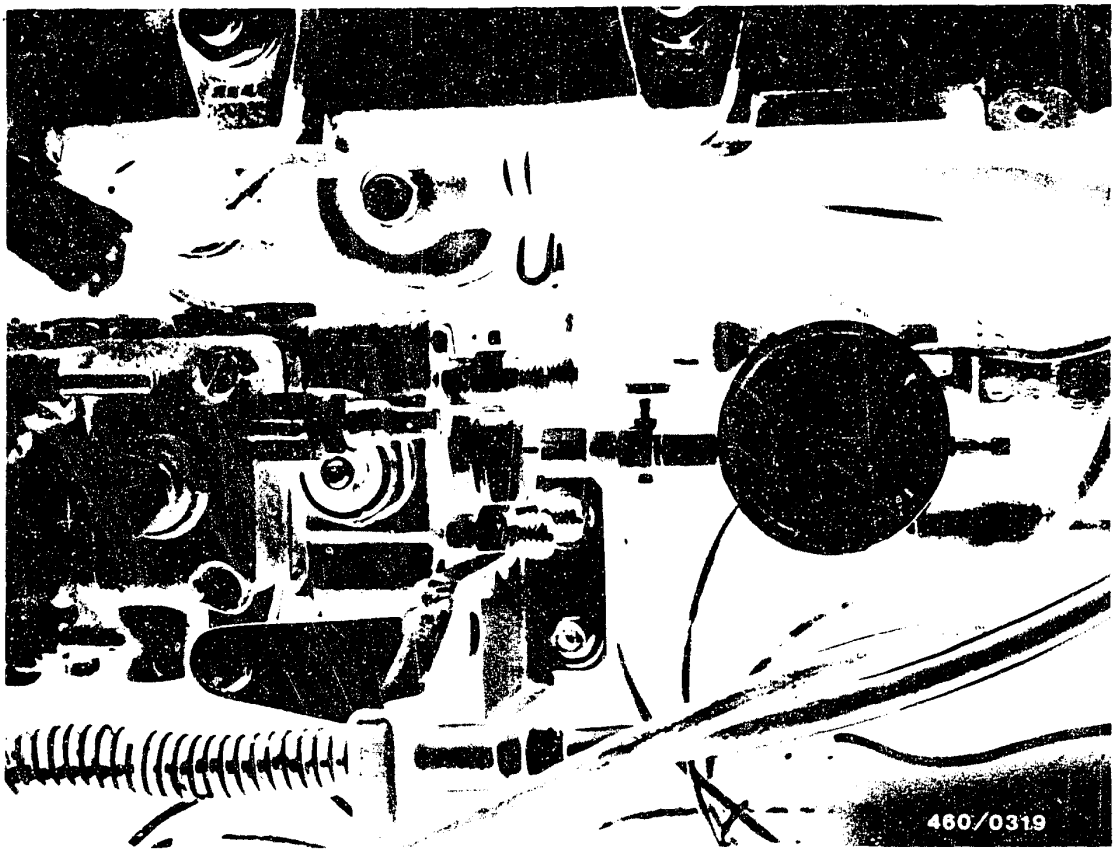
Tighten belt tensioning roller fastening nut to 44 Nm (4.4 kgfm).




Remove bleeder screw from central screw plug (triangular plug) of hydraulic head.

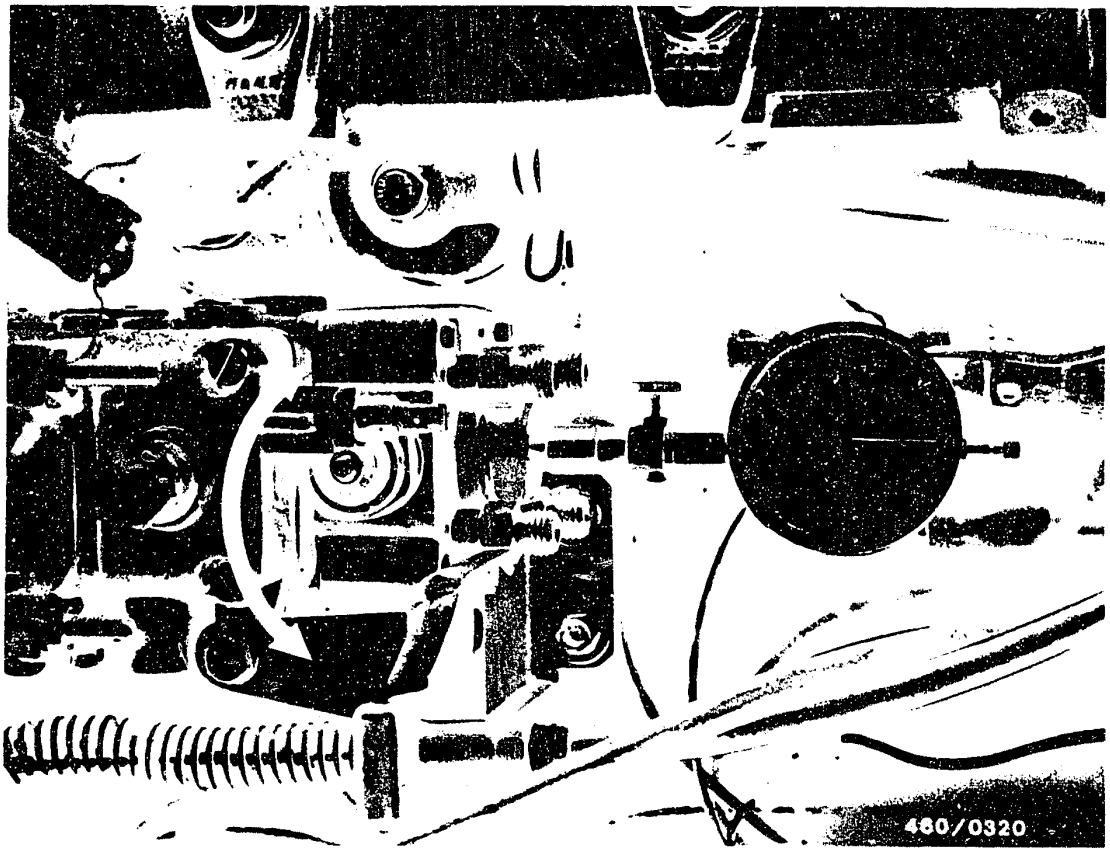
Fit measuring tool KDEP 1085 with dial indicator e.g. 1 687 233 011 into this bore and pre-load by approx. 3 mm.

Turn engine against its direction of rotation until pointer of dial indicator no longer moves.
Pre-load dial indicator by approx. 1 mm and set to "0".




Turn engine in its direction of rotation until the marks on camshaft gear, injection pump gear and crankshaft gear are in alignment with those on the cover plate (cylinder 1 at TDC).

In this position, the dial indicator must indicate a stroke of 1.0 mm.




If it is necessary to make an adjustment, loosen injection-pump fastening screws.

Pivot injection pump until stroke of 1.0 mm is reached.

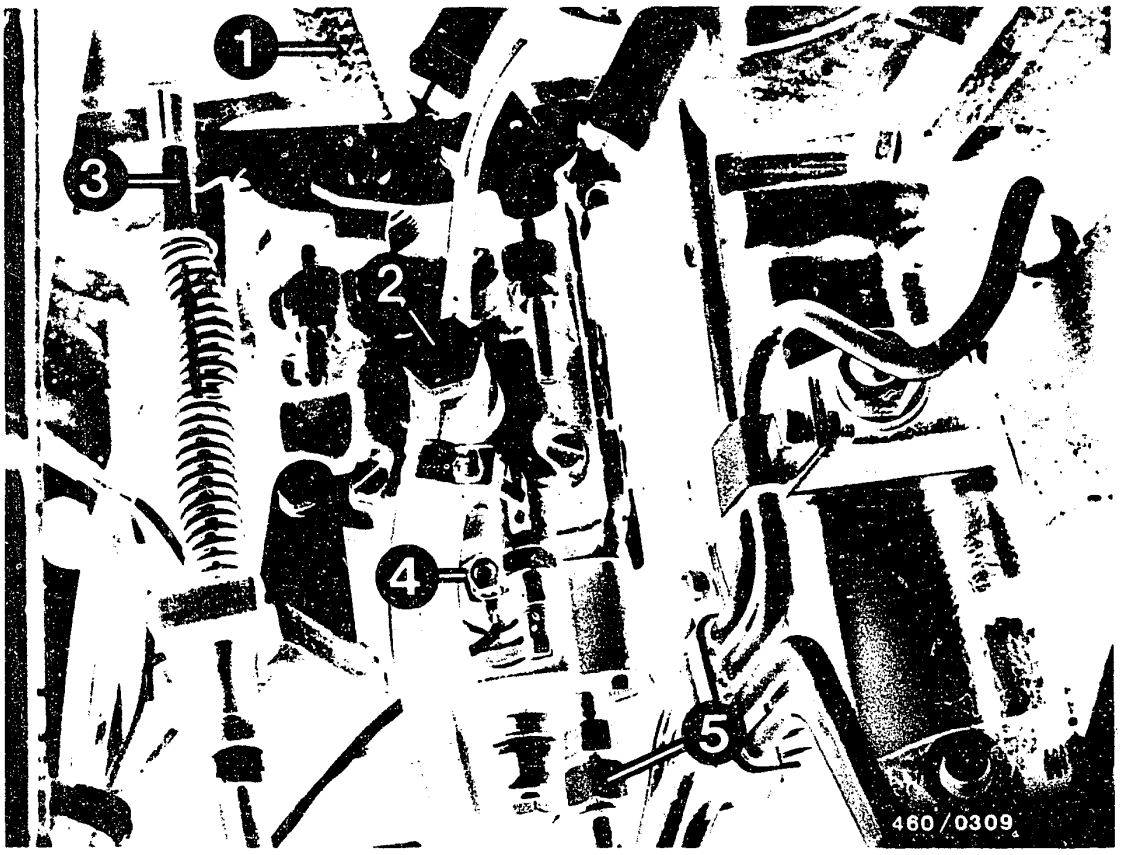
Tighten fastening screws to 29 Nm (2.9 kgfm).

Turn engine over twice and check adjustment once again.

Remove measuring tool KDEP 1085 with dial indicator.

Fit bleeder screw with new seal ring.

Screw down injection-pump support bracket on engine console.

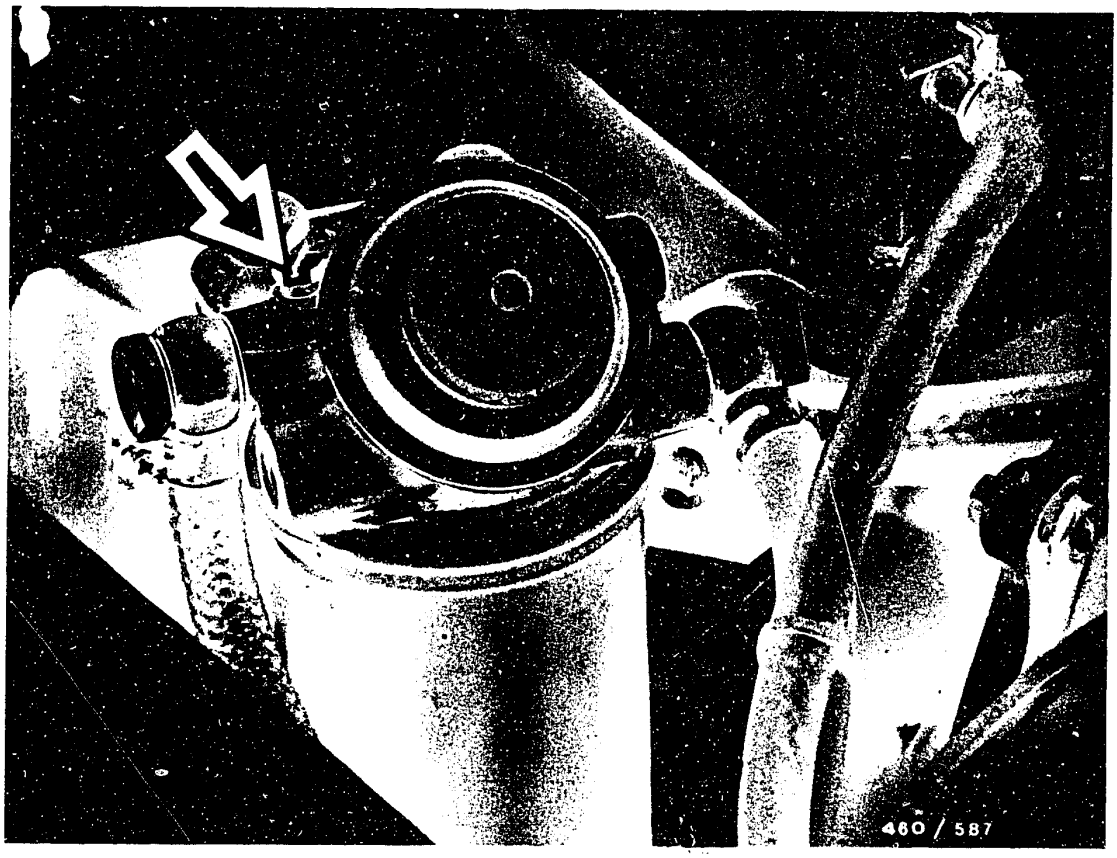



Fit fuel inlet line (1), fuel return line (2), cable (3) on control lever, electric lead (4) on shutoff solenoid and fuel-injection tubing (5) on injection pump.

Note:

Prevent the delivery-valve holders from turning by holding with a wrench.

The inlet-union screws of the fuel inlet and fuel return lines must not be mixed up.
The inlet-union screw of the return line is provided with restriction bores and the head of the screw is marked "OUT".
Fit engine timing cover. Reconnect battery.



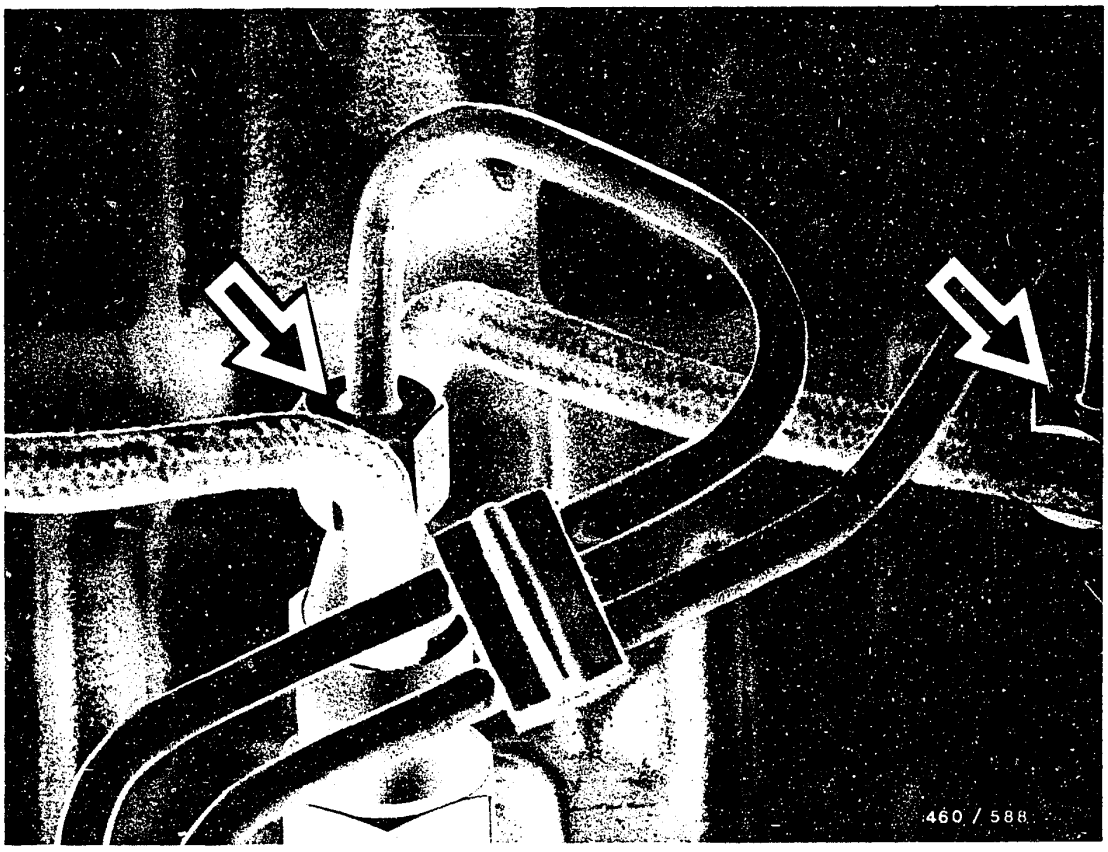

Bleed fuel system.

Loosen bleeder screw on fuel filter (arrow).

Operate hand primer on fuel filter until fuel escaping from the bleeder screw is free of bubbles.

Tighten bleeder screw.

Continue to operate hand primer until resistance can be felt.



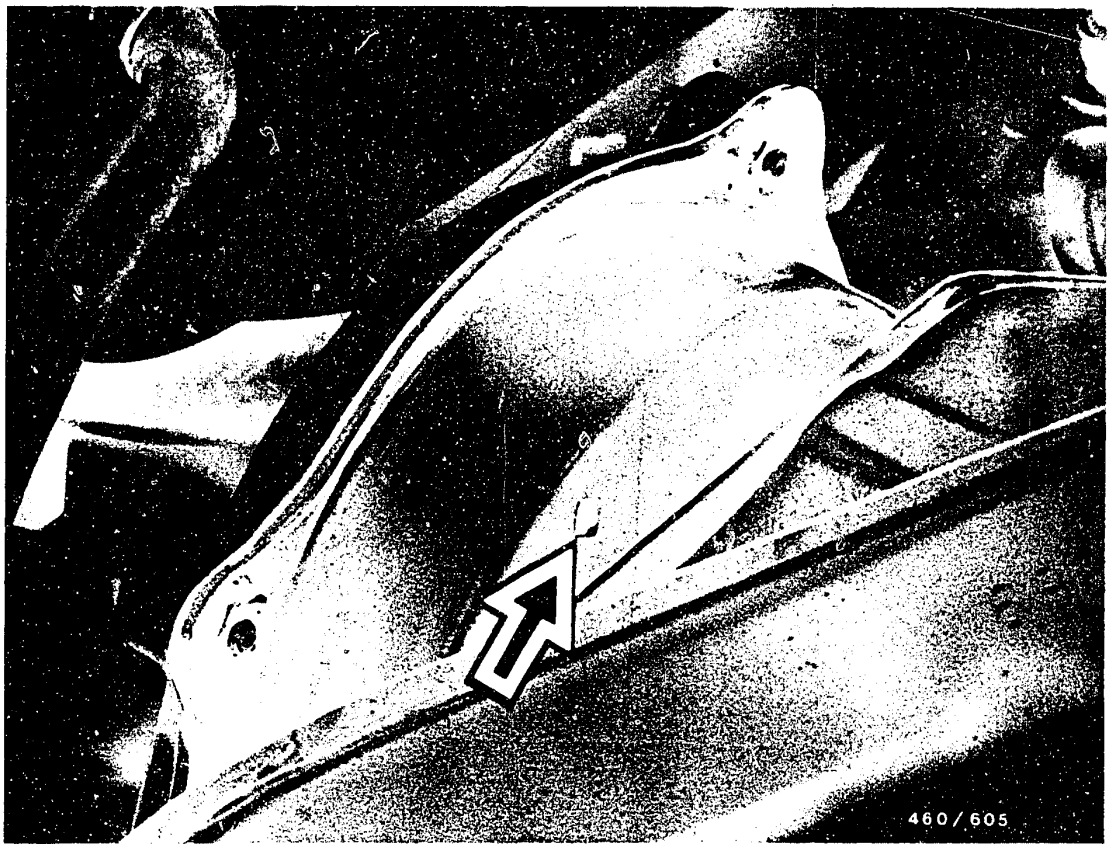

Loosen union nuts of fuel-injection tubing on nozzle-holder assemblies.

Actuate starting motor without preheating. When the fuel escaping from the bleeder hole of the injection pump is free of bubbles, tighten bleeder screw.

Continue to operate starting motor until fuel escapes from union nuts of nozzle-holder assemblies (arrows).

Tighten union nuts.

Actuate starting motor until engine starts.

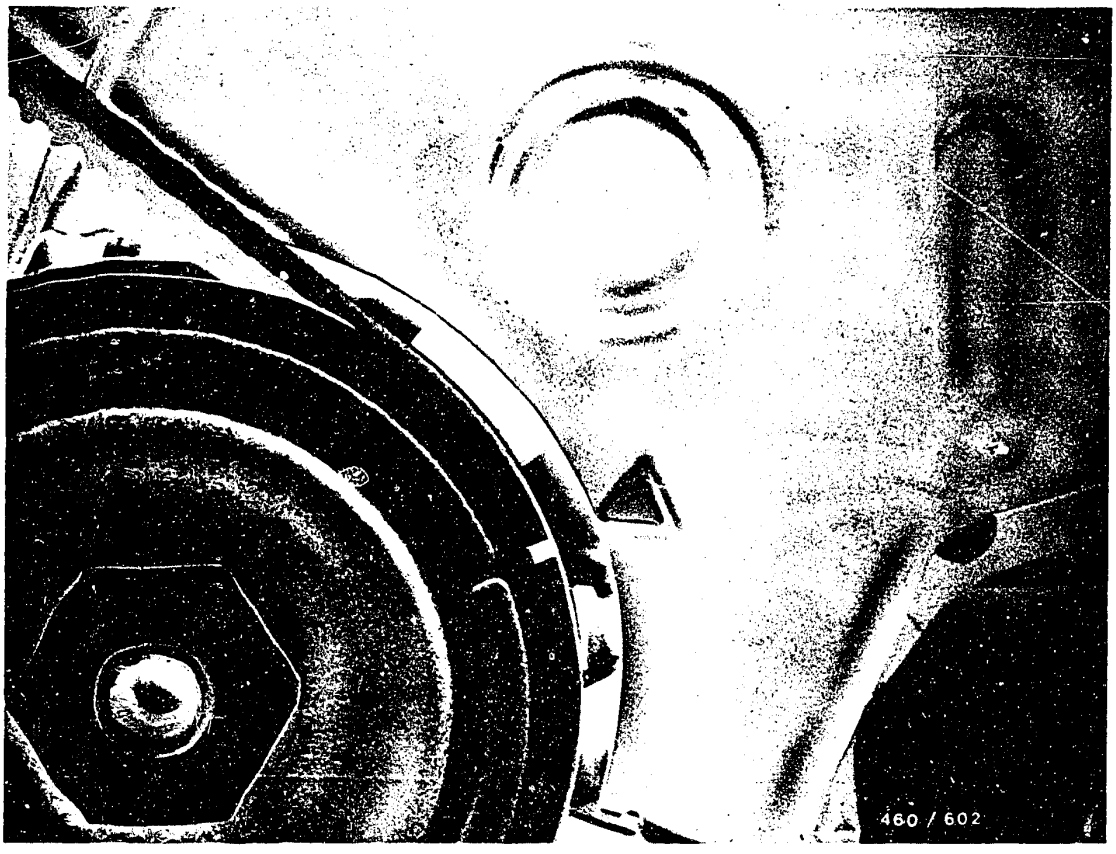



## 25. Check and adjust engine timing

### 25.1 Check engine timing

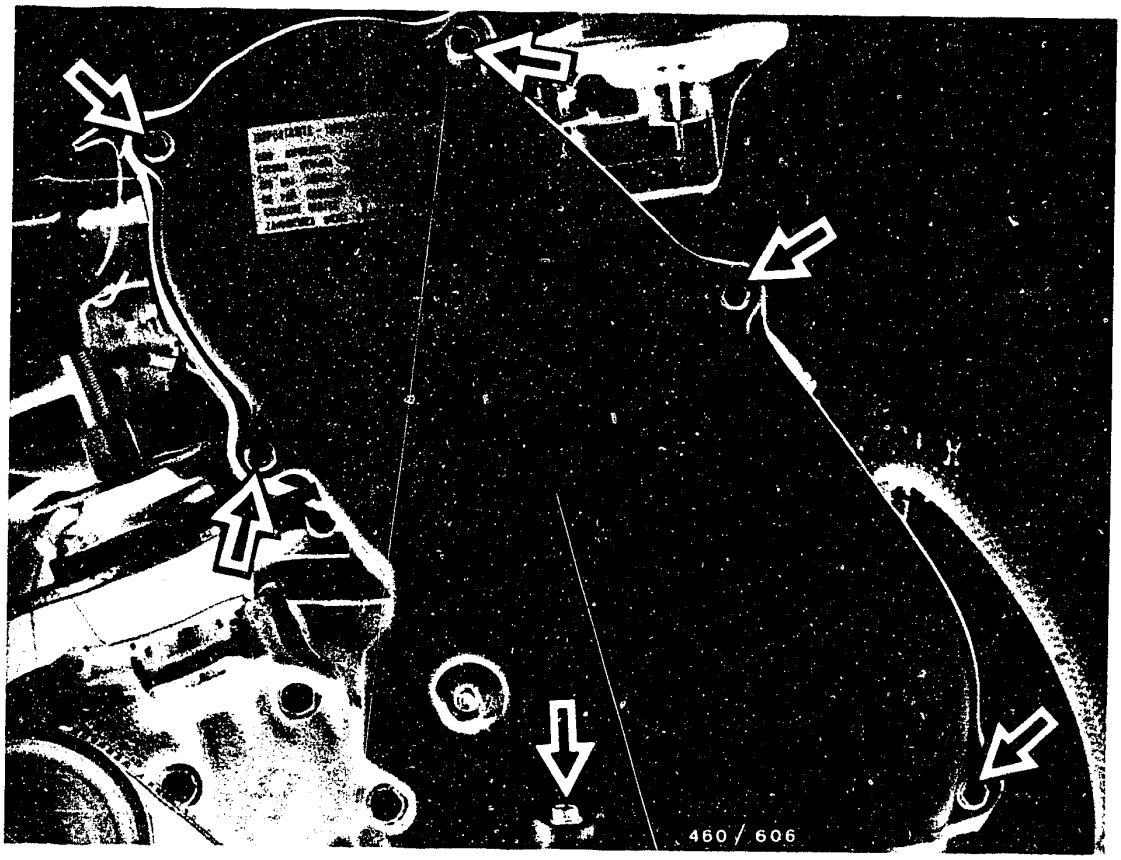
Remove cover for engine timing and injection-pump drive.

Turn crankshaft in engine direction of rotation until marks on camshaft gear and cover plate are in alignment (picture, arrow).



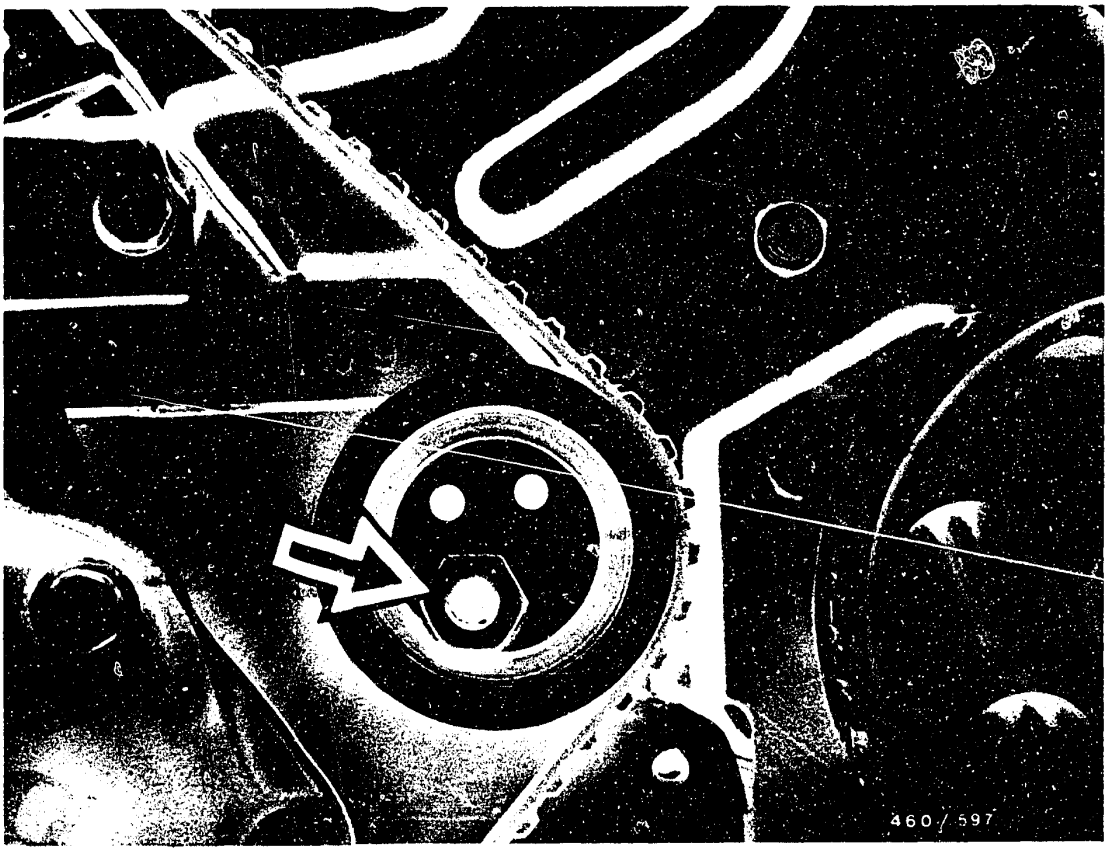

The marks on pulley (on crankshaft of engine) and on lower cover plate must be in alignment.

If the marks are not in alignment, it is necessary to adjust the engine timing.



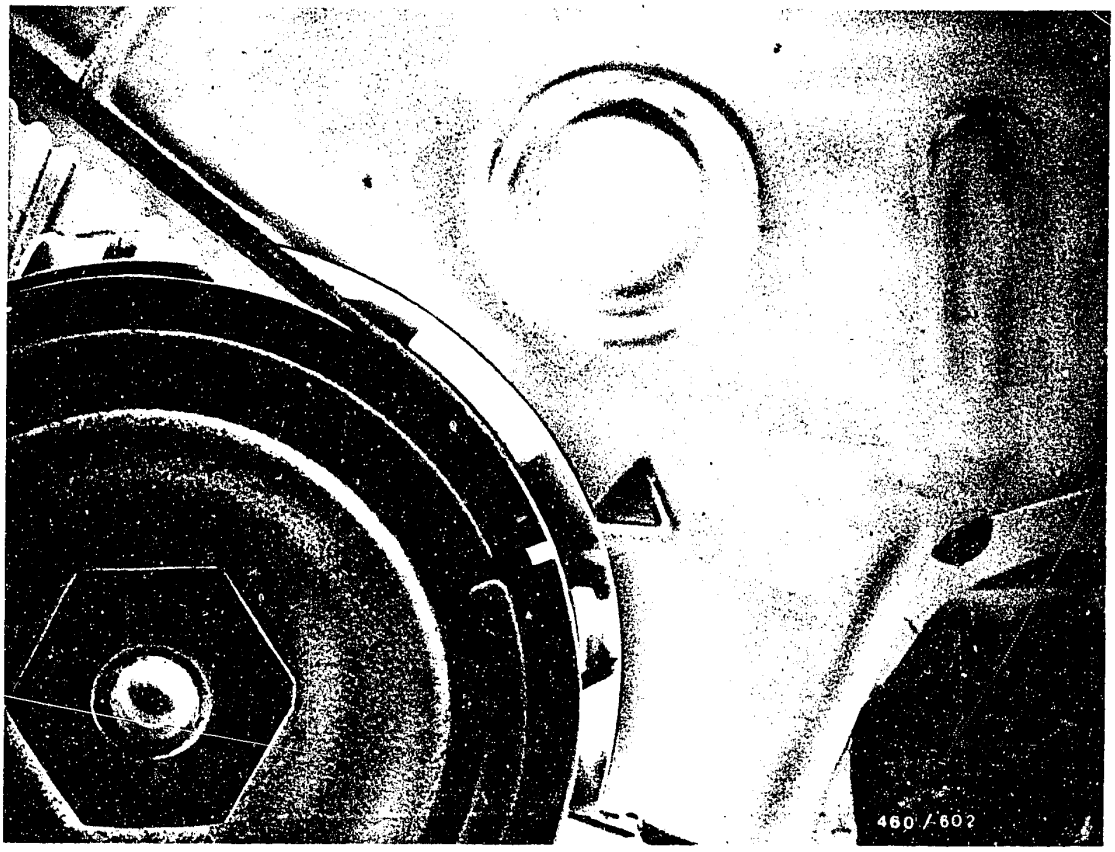

25.2 Adjust engine timing

Unscrew fastening screws from upper cover plate (arrows).

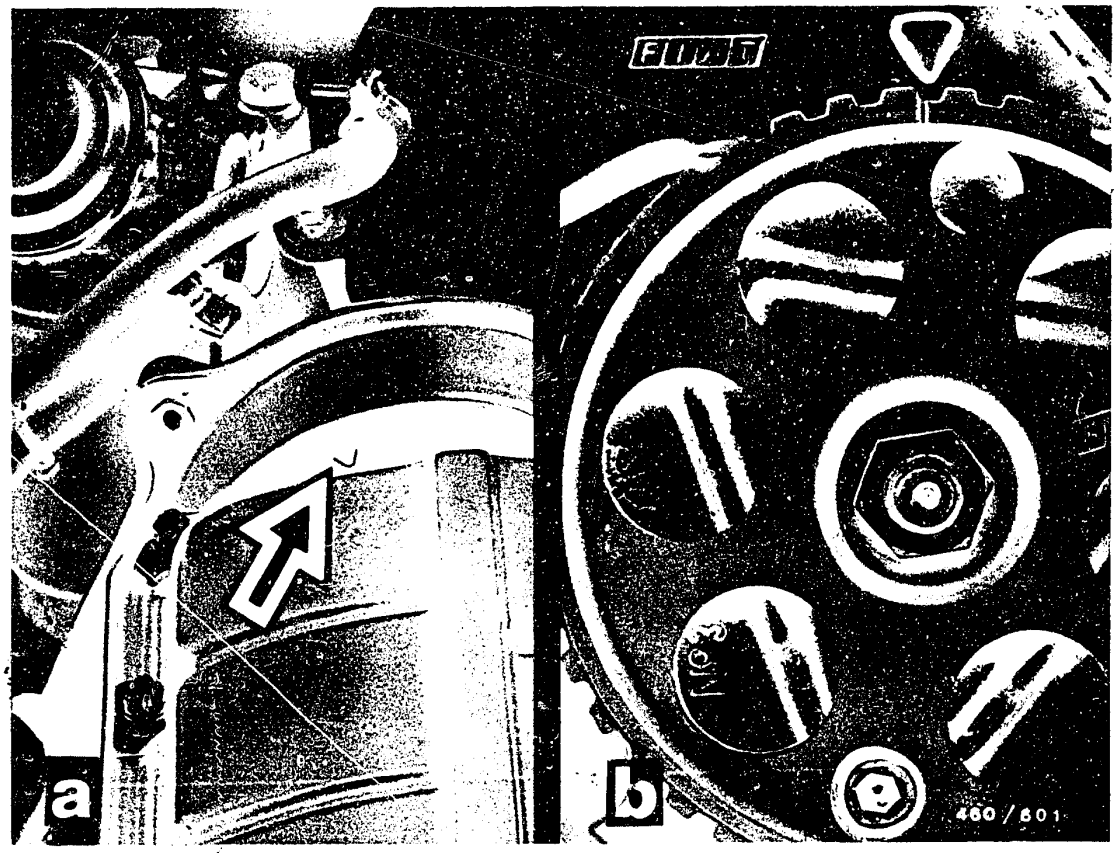



Loosen belt tensioning roller fastening screw (arrow).

Remove toothed belt from camshaft gear and injection-pump gear.

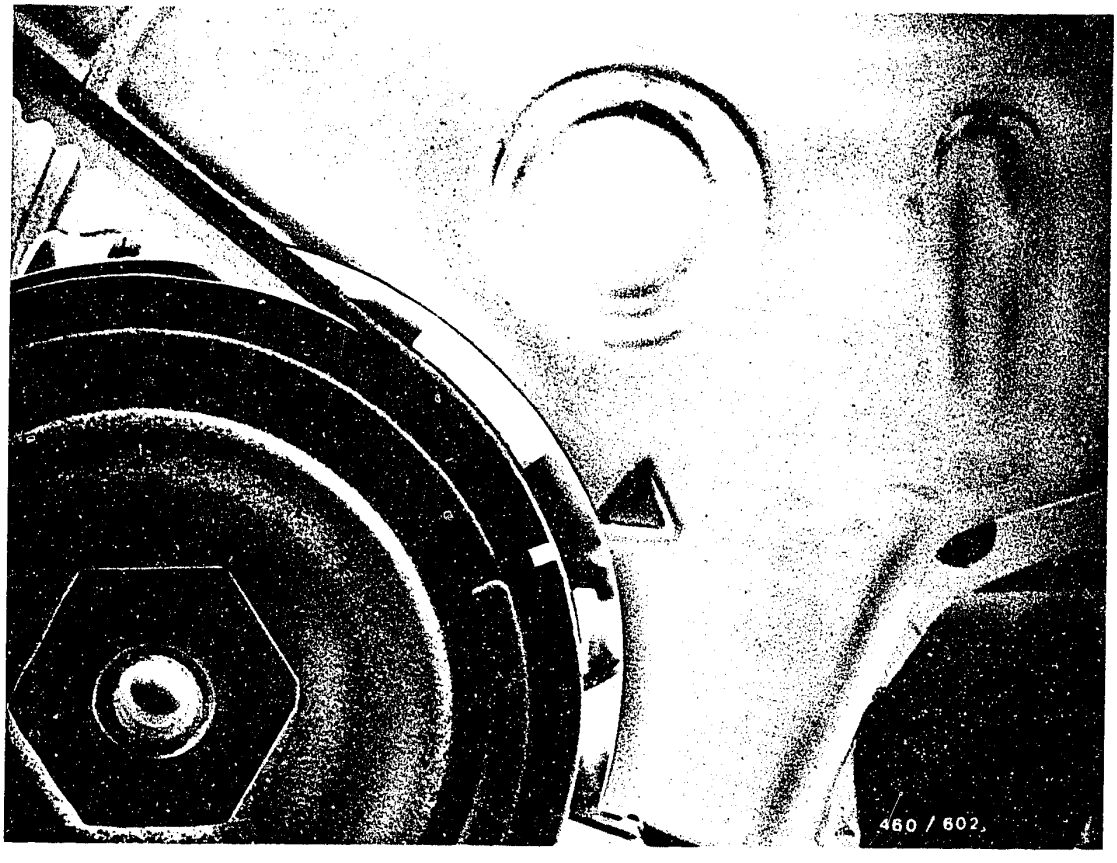



Turn crankshaft until mark on pulley aligns with reference mark on cover plate.




Re-position toothed belt.

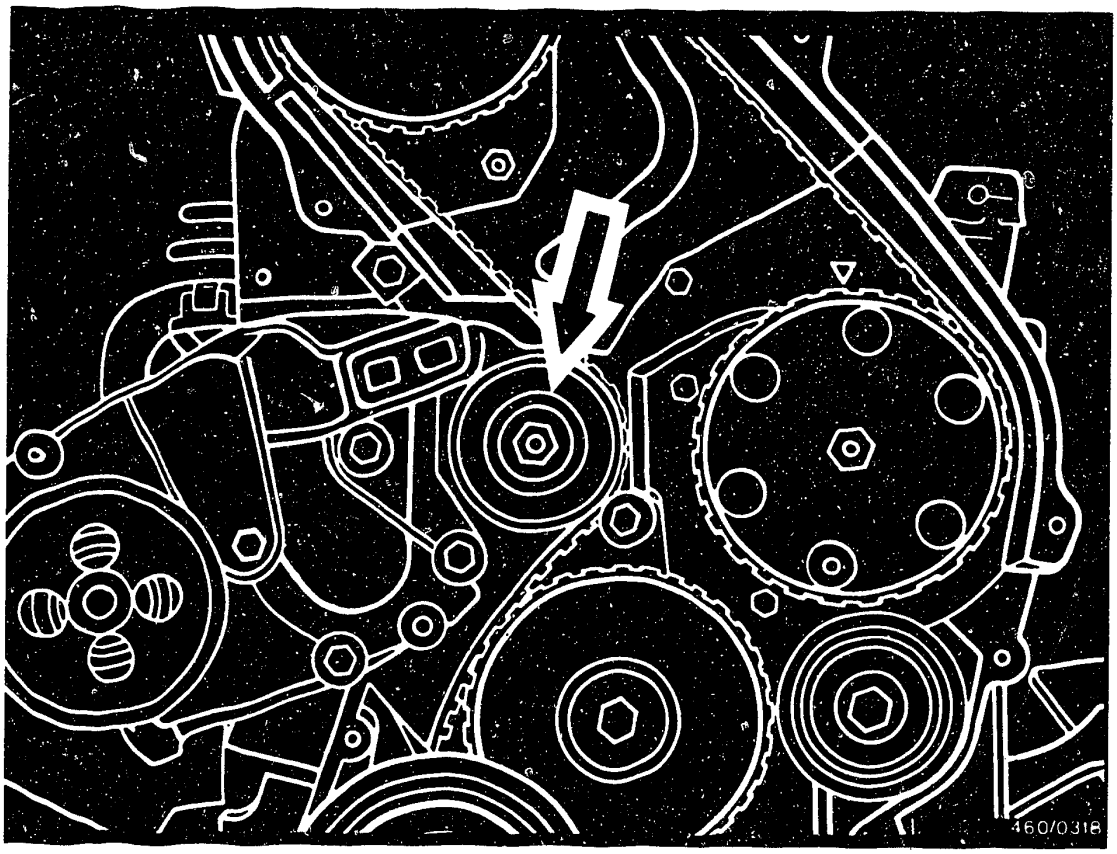
Make sure that the marks on camshaft gear (Fig. a, arrow) and injection-pump gear (Fig. b) point to the reference marks on the cover plate.




The mark on the crankshaft gear pulley points to the reference mark on the cover plate (see picture).

To check the position of the toothed belt, remove bottom engine-timing cover plate and check whether toothed belt is resting correctly on crankshaft gear.

Remount cover plate.

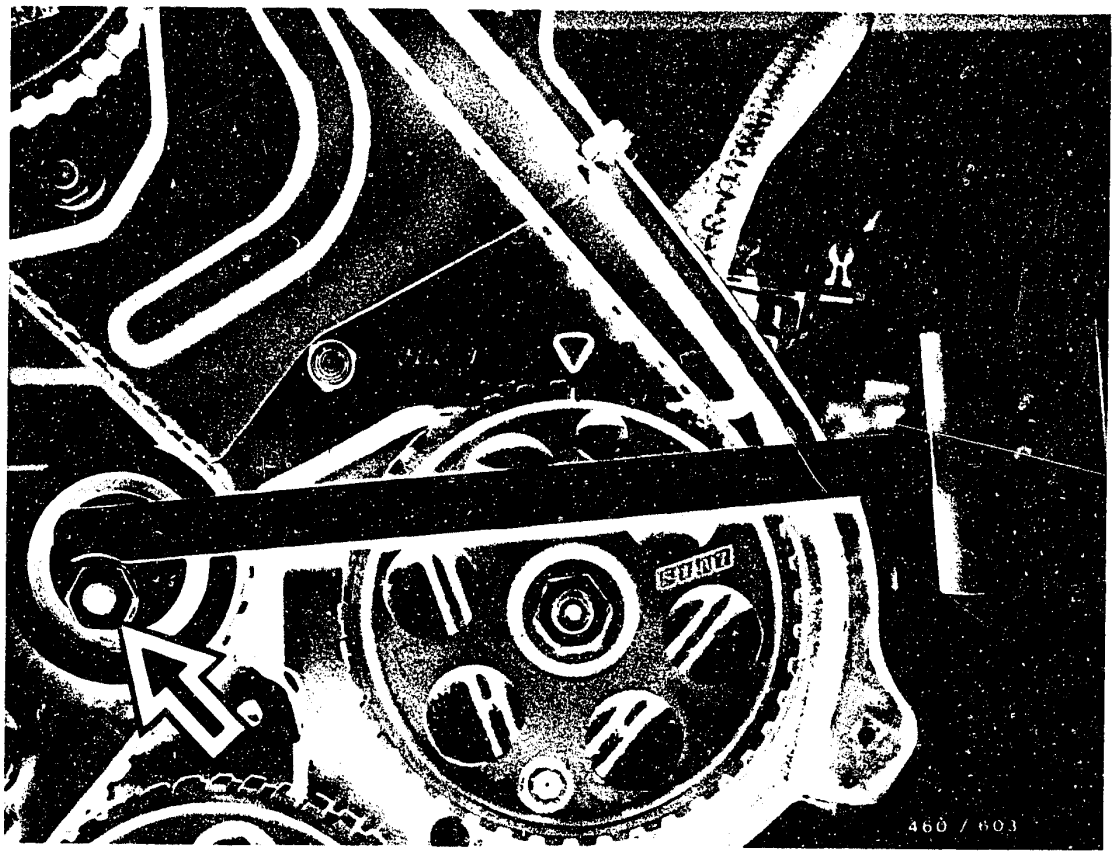



Only Ritmo - date of manufacture 10.79 - 10.82

Loosen belt tensioning roller holder fastening screw (arrow) until spring-loaded belt tensioner presses against toothed belt.

Re-tighten fastening screw.
Turn crankshaft over two complete times in engine direction of rotation until the marks on camshaft gear, injection-pump gear and crankshaft gear are in alignment with those on the cover plate.

Loosen belt tensioning roller holder fastening screw until spring-loaded belt tensioner presses against toothed belt.
Tighten fastening screw to 44 Nm (4.4 kgfm).

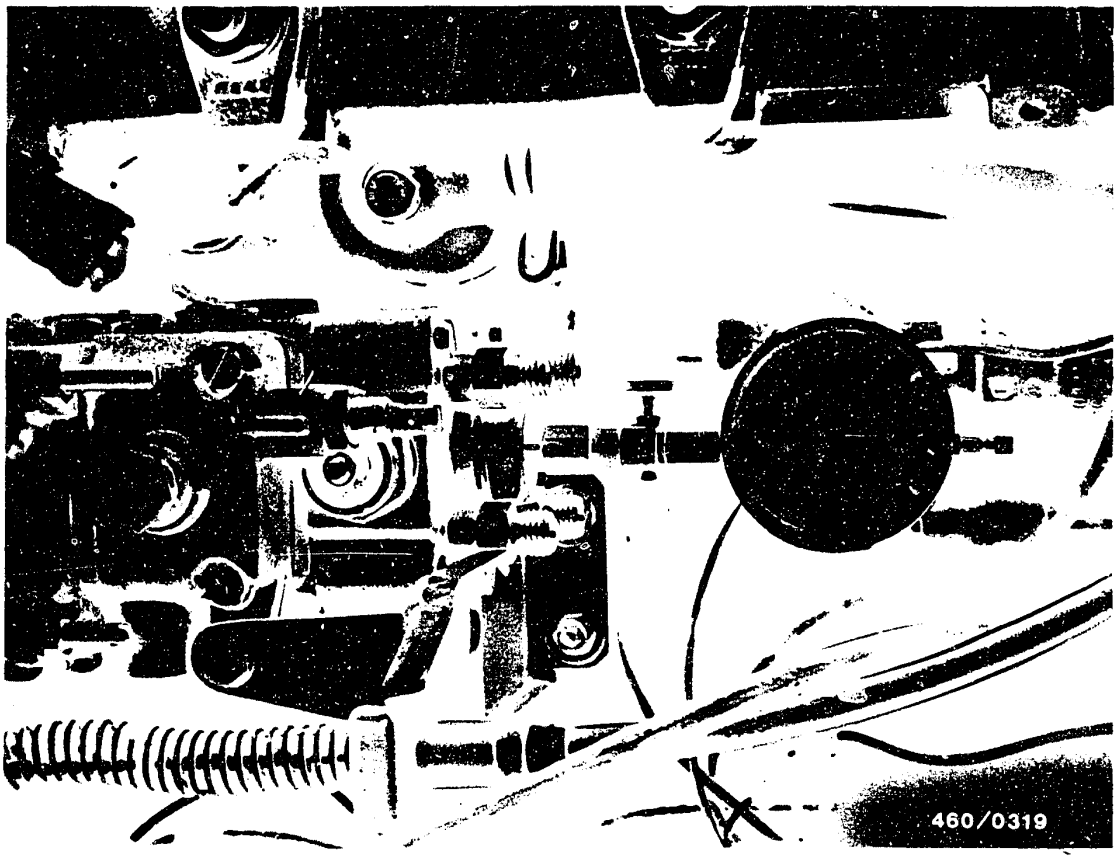



Only Ritmo as of 10.82 date of manufacture

Loosen belt tensioning roller fastening nut (arrow). Turn belt tensioning bearing in clockwise direction and position tool A.60722 for tensioning toothed belt.

Turn crankshaft over twice in engine direction of rotation until the marks on camshaft gear, injection-pump gear and crankshaft gear are in alignment with those on the cover plate.

Tighten belt tensioning roller fastening nut to 44 Nm (4.4 kgfm) (arrow).

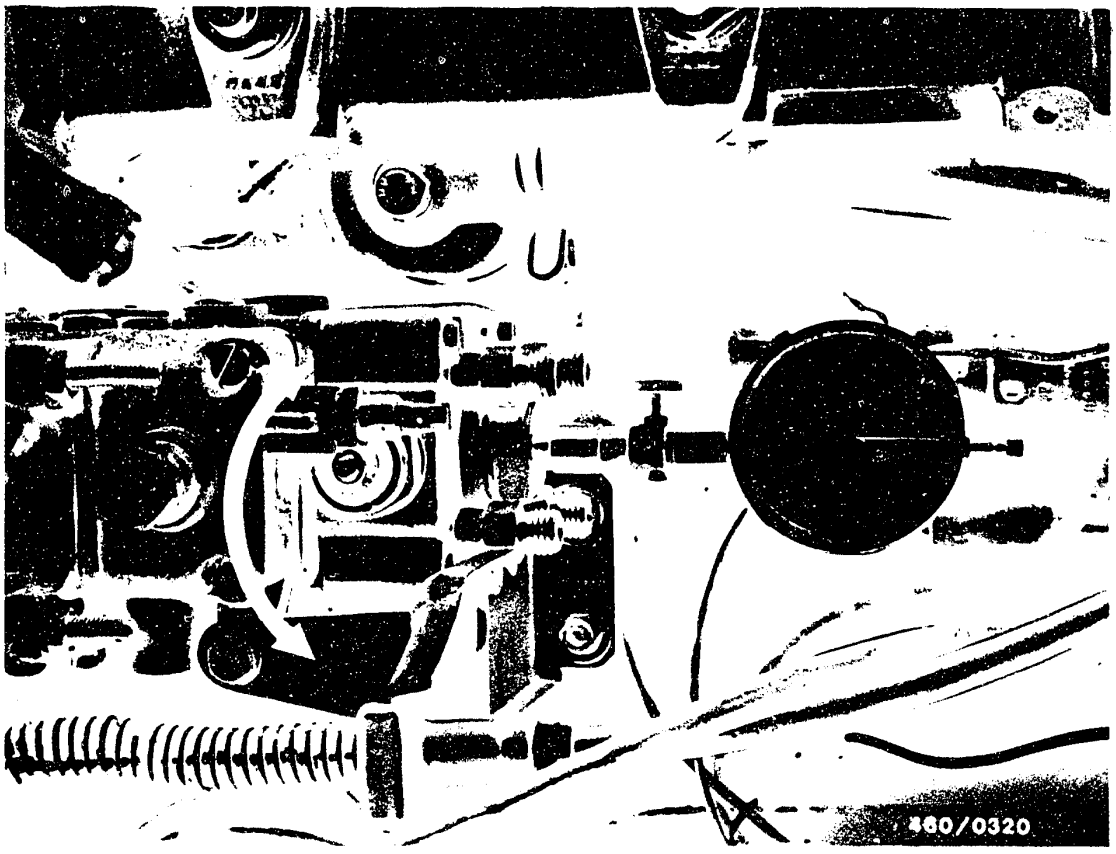



Remove injection lines from injection pump and nozzle-holder assemblies (prevent delivery-valve holders from coming loose by holding with a wrench).

Remove bleeder screw from central screw plug (triangular plug) of hydraulic head.

Fit measuring tool KDEP 1085 with dial indicator e.g. 1 687 233 011 into this bore and pre-load by approx. 3 mm.

Turn engine against its direction of rotation until pointer of dial indicator no longer moves.
Pre-load dial indicator by approx. 1 mm and set to "0".

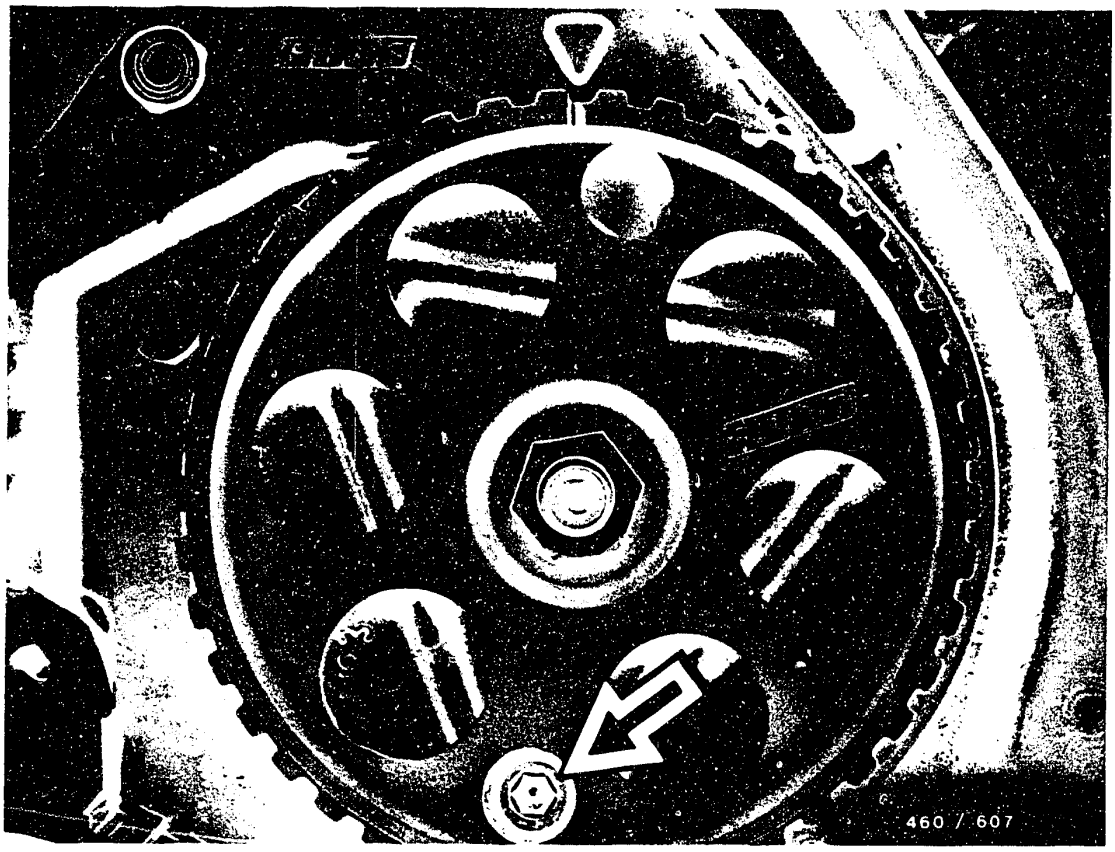



Turn engine in its direction of rotation until the marks on camshaft gear, injection pump gear and crankshaft gear are in alignment with those on the cover plate (cylinder 1 at TDC).

In this position, the dial indicator must indicate a stroke of 1.0 mm.

If it is necessary to make an adjustment, loosen injection-pump fastening screws.

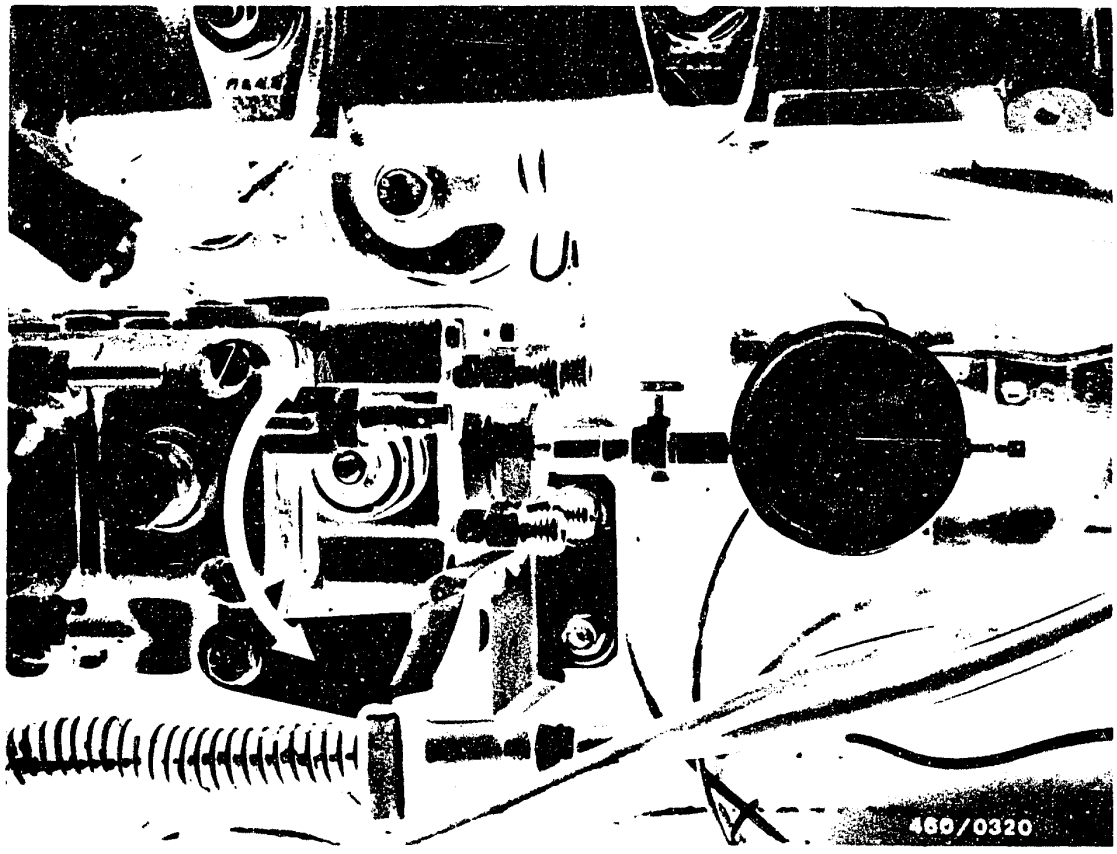
Pivot injection pump until stroke of 1.0 mm is reached.




Note:

The lower fastening screw on the pump flange is screwed in from the drive side.
It is a hexagon-socket-head cap screw (arrow).

Loosen fastening nuts on pump flange and fastening screws on hydraulic head support bracket.




Pivot injection pump until stroke of 1.0 mm is reached.

Tighten fastening screws to 29 Nm (2.9 kgfm).

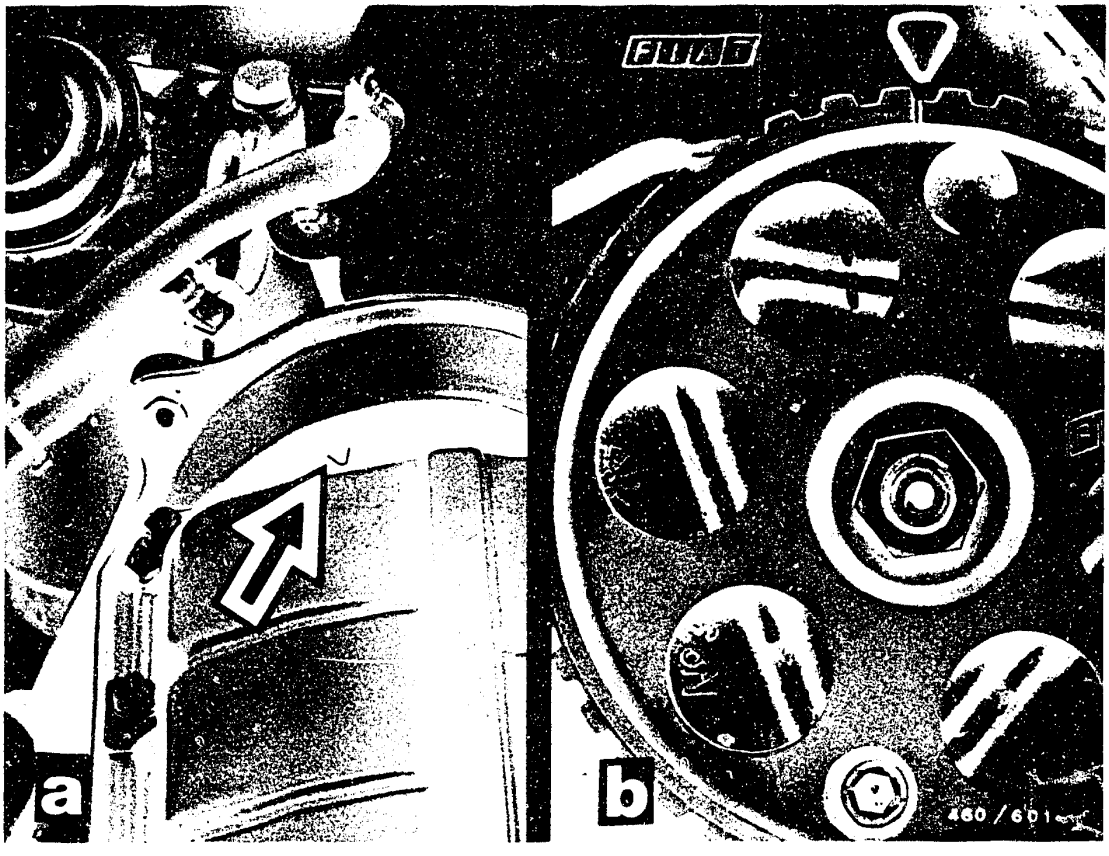
Turn engine over twice and check adjustment once again.

Remove measuring tool KDEP 1085 with dial indicator.

Fit bleeder screw with new seal ring.

Secure injection lines on delivery-valve holders of injection pump and on nozzle-holder assemblies (hold delivery-valve holders with a wrench).

Fit engine timing cover plate.

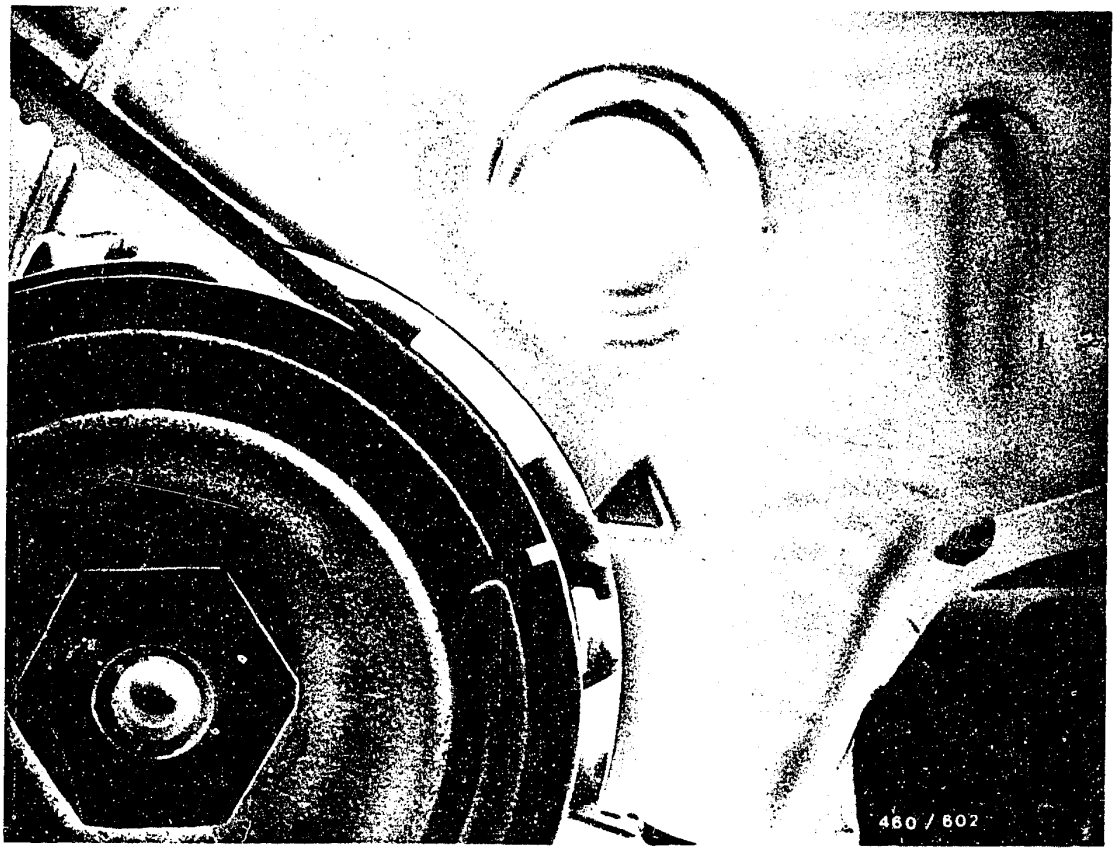



## 26. Injection timing

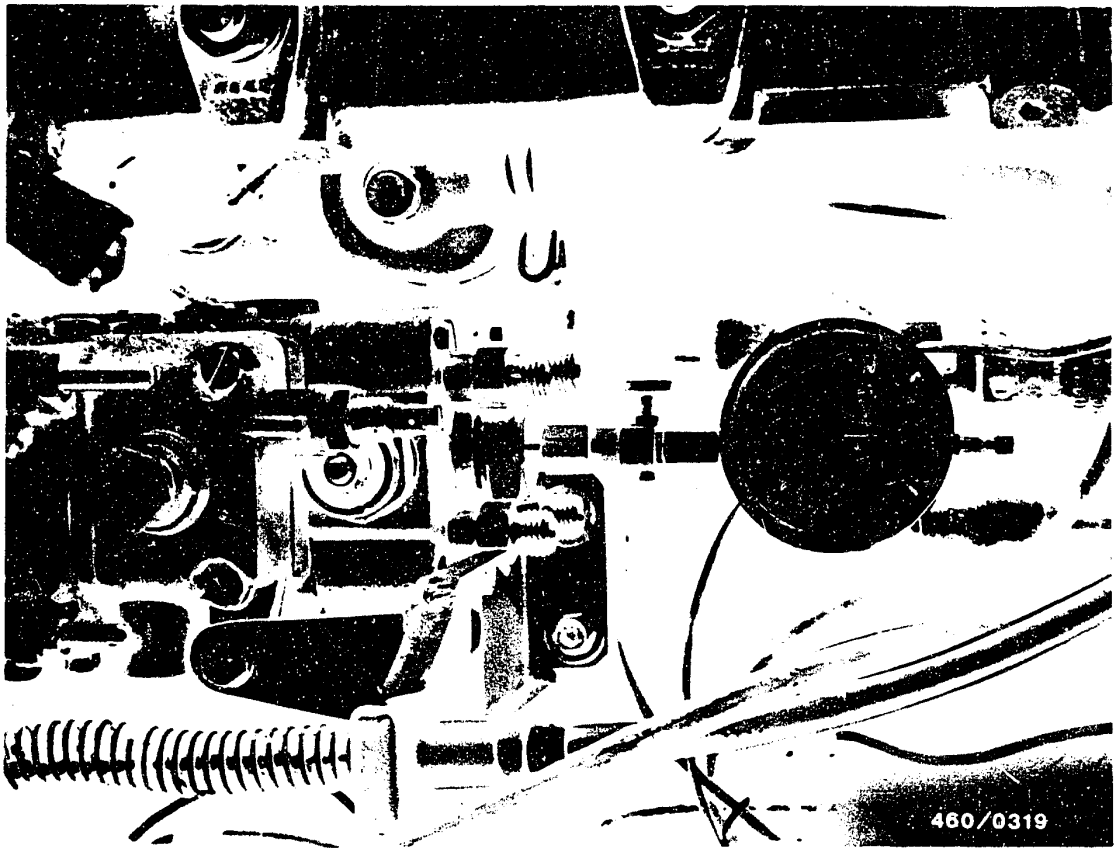
Remove engine timing cover.

Remove injection lines on injection pump and nozzle-holder assemblies (prevent delivery-valve holders from coming loose by holding with a wrench).

Turn crankshaft in engine direction of rotation until the marks on camshaft gear (Fig. a) and injection-pump gear (Fig. b) are in alignment with those on the cover plate.



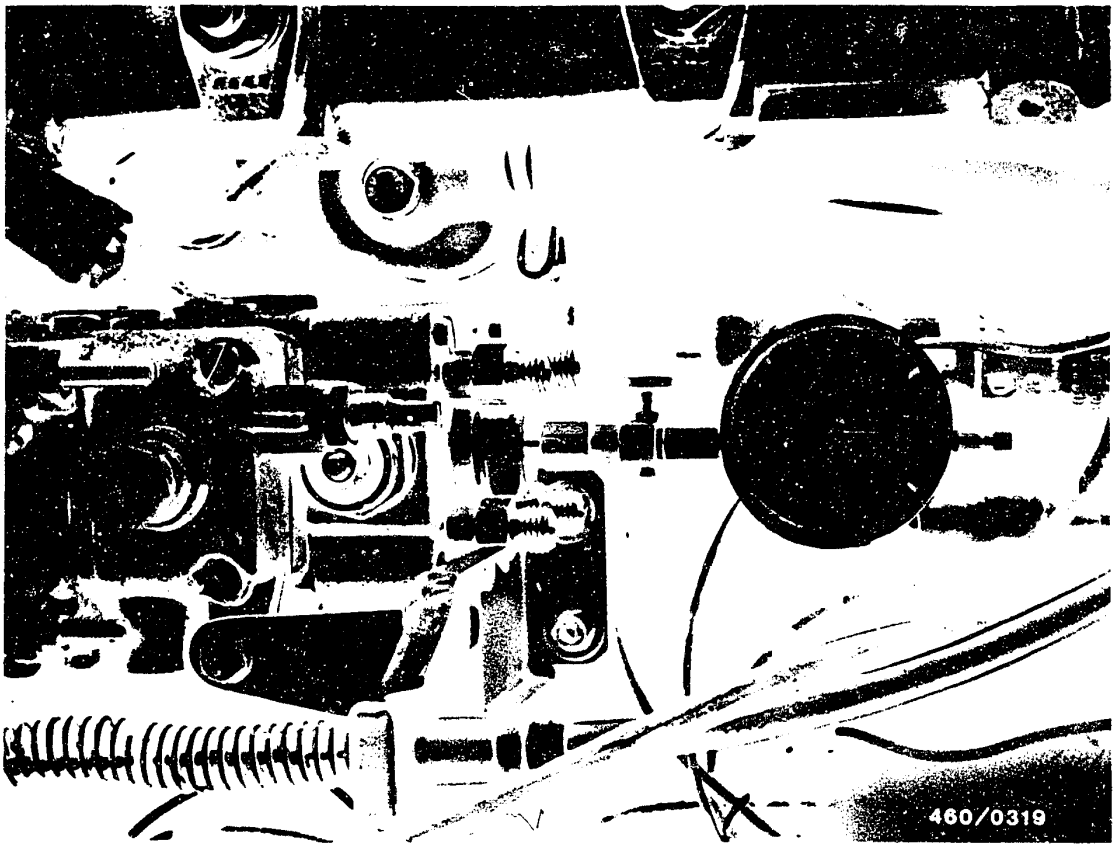

The mark on the crankshaft gear pulley points to the reference mark on the cover plate.




Remove bleeder screw from central screw plug (triangular plug) of hydraulic head.

Fit measuring tool KDEP 1085 with dial indicator e.g. 1 687 233 011 into this bore and pre-load by approx. 3 mm.

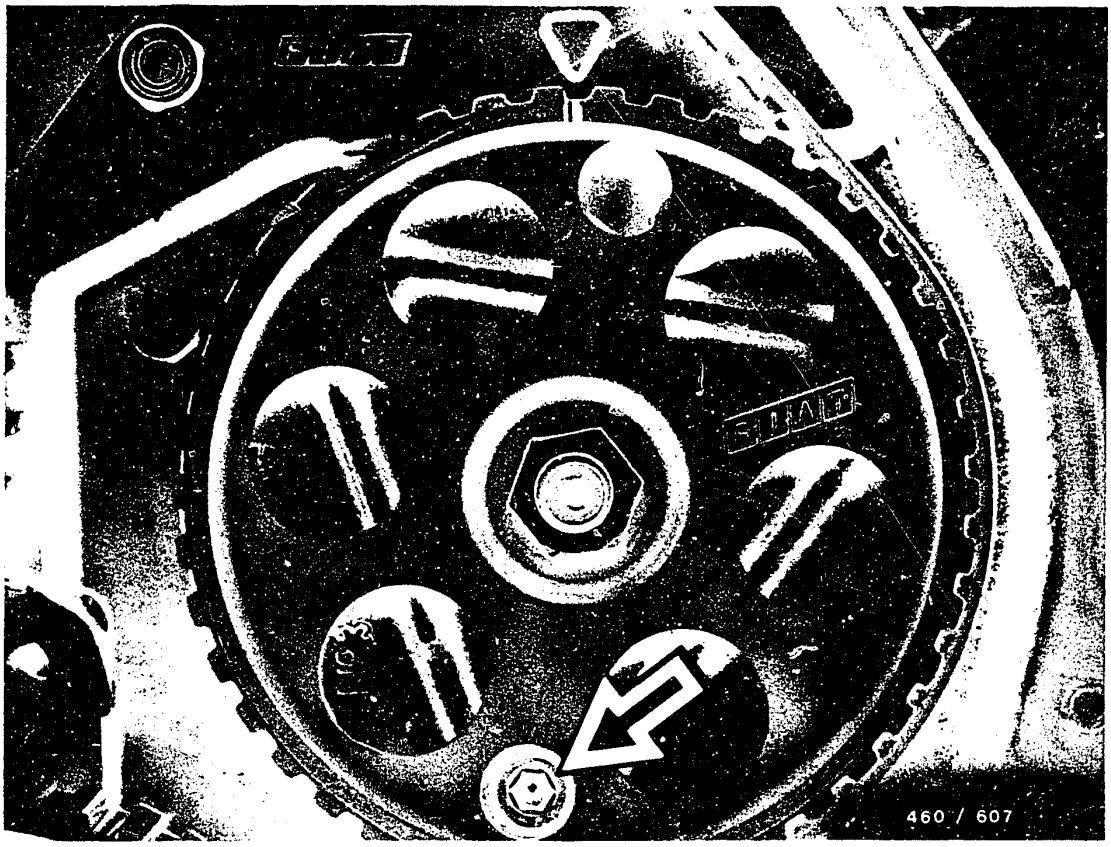
Turn engine against its direction of rotation until pointer of dial indicator no longer moves.
Pre-load dial indicator by approx. 1 mm and set to "0".




Turn crankshaft in engine direction of rotation until the marks on camshaft gear and injection-pump gear are in alignment with the reference marks on the cover plate.

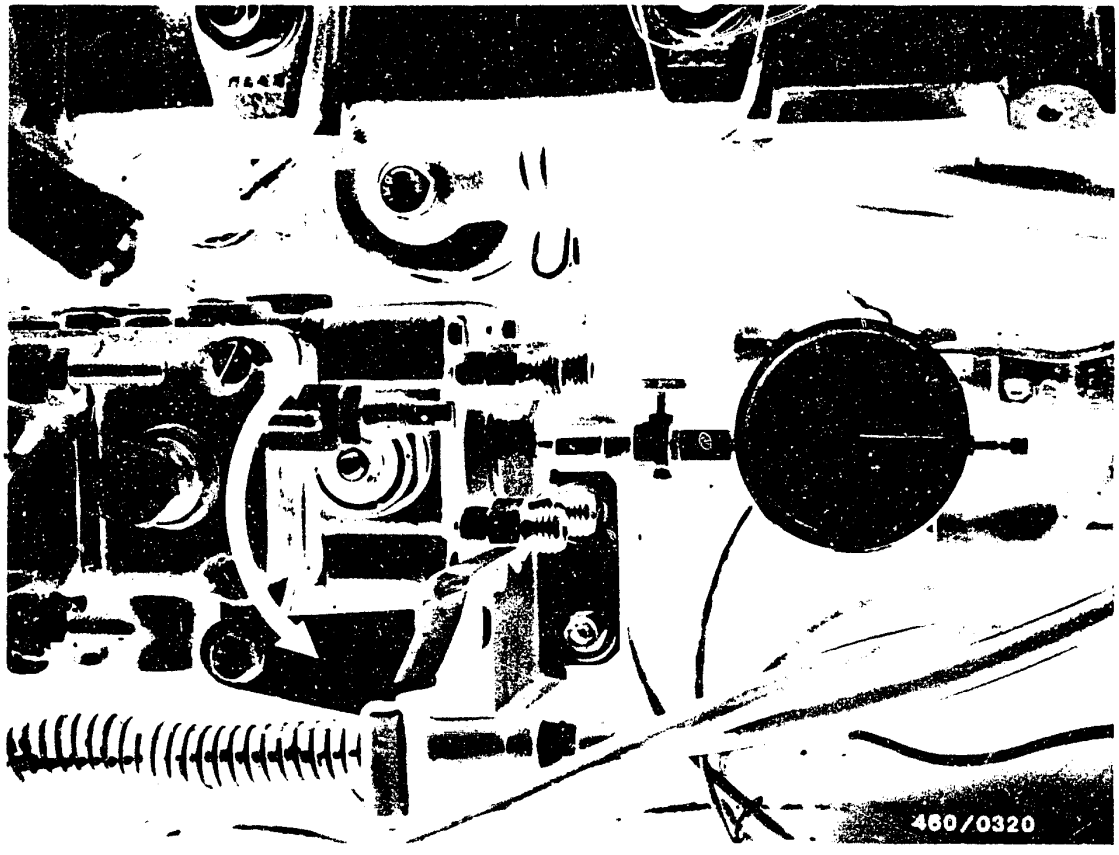
In this position, the dial indicator must indicate a stroke of 1.0 mm.

If it is necessary to make an adjustment, loosen injection-pump fastening screws.




Note:

The lower fastening screw on the pump flange is screwed in from the drive side.
It is a hexagon-socket-head cap screw (arrow).




Pivot injection pump until stroke of 1.00 mm is reached.

Tighten fastening screws to 29 Nm (2.9 kgfm).

Turn engine over twice and check adjustment once again.

Remove measuring tool KDEP 1085 with dial indicator.

Fit bleeder screw with new seal ring.

Secure injection lines on delivery-valve holders of injection pump and on nozzle-holder assemblies (hold delivery-valve holders with a wrench).

Fit engine timing cover plate.

# After-sales Service

## Motor Vehicle Service Information



FIAT RITMO DIESEL

with VE 4/9 F 2300 R 54
0 460 494 044
Optimization of warm-up phase

VDT-I-FIA 022 En
2.1983
(Supersedes 6.1982 edition)

In order to improve the warm-up phase, FIAT has released a modified timing-device cover for vehicles with heavy blue smoke generation.

This timing-device cover KDEP 1129 can be ordered from KH/VKD4. Unit price DM 3.50. Minimum order 10 units.

Conversion is subject to payment in all cases.

In case of conversion, remove the distributor-type pump and proceed as follows:

1. Replace the pressure-side timing-device cover with a special cover KDEP 1129.

2. Set the injection timing.

   Injection pump: 1.25mm $\pm$ 0.05 mm after BDC

   Engine: TDC mark cyl. 1 on flywheel

3. Mark the pump with a "1" after the part number.

4. The testing and setting of the pump on the test bench do not change.

The modified timing-device cover KDEP 1129 can be obtained immediately within Germany from

Robert BOSCH GmbH
Abt. KH/VKD4
Auf der Breit 4
Postfach 41 09 60
7500 Karlsruhe 41 Telex 7 826 663

and outside Germany from RG/AV.

BOSCH Geschäftsbereich KH Kundendienst Kfz-Ausrüstung

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Department for Technical Publications KH/VDT,
Postfach 50, D-7000 Stuttgart 1

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